

# NATURAL HISTORY

MASTODONS OF THE HUDSON HIGHLANDS

BY HENRY FAIRFIELD OSBORN

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CENTURY-OLD FISHING DEVICES STILL IN USE

BY R. E. COKER

---

THE BIRDS OF THE SOUTH PACIFIC ISLANDS

BY ROLLO H. BECK

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CIRCUS APES I HAVE KNOWN

BY W. HENRY SHEAK

---

BOLIVIA'S LEAST-KNOWN MOUNTAIN RANGE

BY EDWARD W. BERRY

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RACIAL DIVERSITY OF POLYNESIA—REVIEWS BY WILLIAM BEEBE  
AND GEORGE F. KUNZ—A GIANT SHARK RAMMED BY  
A STEAMER—A NEW METEORITE

## JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

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# NATURAL HISTORY

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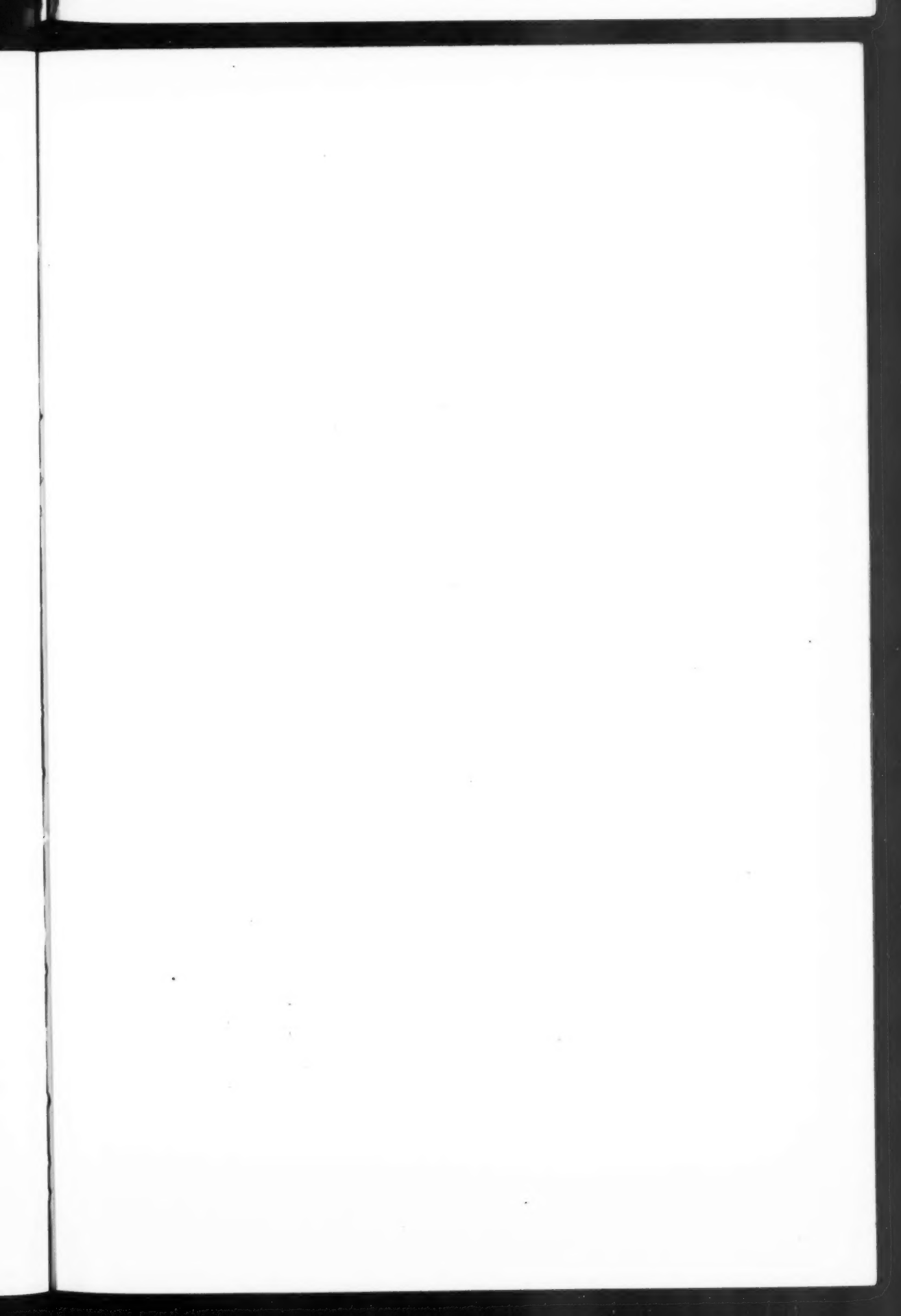
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THE FINAL RESTORATION PORTRAIT OF THE WARREN MASTODON.—It represents the animal as he appeared in life just before he sank into the shell-marl basin, six miles northwest of Newburg, between 20,000 and 30,000 years ago. The painting was executed by Charles R. Knight in 1908, under the direction of Henry Fairfield Osborn. In the right distance is the north gap in the Hudson River Highlands, Storm King mountain on the right and Break Neck on the left. In the foreground is one of the shallow sheets of water covering the shell-marl in which the remains of the animal were so perfectly preserved. The flora of the forest corresponds with the description of Professor Asa Gray in letters addressed to Doctor Warren, describing the contents of the mastodon's stomach: "On examination by the microscope, the fragments present the aspect of the terminal bough of coniferous trees . . . from the structure of the woody fibre, they were boughs of pine or spruce of some sort, and they minutely agree with the wood of hemlock spruce; so that this is very probably the species they belonged to, but there is no certainty of it."



# NATURAL HISTORY

VOLUME XXIII

JANUARY-FEBRUARY, 1923

NUMBER I

## Mastodons of the Hudson Highlands

By HENRY FAIRFIELD OSBORN

President of The American Museum of Natural History

One of the greatest treasures of the American Museum is the unrivaled skeleton of the fossil proboscidean known as the WARREN MASTODON. The present article gives the fullest and most authentic history of this specimen which has ever been published, thanks to the testimony of several eyewitnesses who have kindly written to the author and to others.

THE WARREN MASTODON, found in 1845, was the fifth in a series of discoveries of mastodon skeletons, beginning with Peale's first skeleton of 1799, which like the WARREN MASTODON was found in Orange County, New York. The first reference to mastodons along the Hudson was, however, as early as 1705.

The following table relative to early discoveries of the mastodon has been compiled from *The Mastodon Giganteus of North America*, which Dr. John Collins Warren published in 1852:

- 1705.—First mention of finding mastodon remains near Albany.
- 1714.—First published account of two teeth and a thigh bone found at Claverack, on the Hudson, thirty miles south of Albany.
- 1799–1801.—Peale's first skeleton, found on John Masten's farm, Orange County, New York. See Warren, Plate I, upper left-hand figure. Exhibited in London; in Peale's Museum, Philadelphia; and then disappeared.
- 1802.—Peale's second skeleton, "Baltimore Skeleton," purchased by Doctor Warren in 1848, dismantled. A very large jaw, described by Doctor Warren. See Warren, Plate I, upper right-hand figure.
- 1840–43.—Koch's "Missourium," a composite of several specimens found near Kimmiswick, Missouri. Remounted by Richard

Owen, in the British Museum. See Warren, Plate I, lower right-hand figure.

- 1844–45.—"Cambridge mastodon," found near Hackettstown, Warren County, New Jersey, twenty miles from Newark. See Warren, Plate I, lower left-hand figure.

- 1844.—"Shawangunk Skull," found near Scotchtown, Orange County, New York; now in the American Museum. Warren Collection.

- 1845.—The WARREN MASTODON in the American Museum, found on the Brewster Farm, Orange County, New York. See Warren Memoir, Vignette; also Plate I, center figure; also Plates IV to XXV.

In *An Outline History of Orange Co.*, by Samuel W. Eager, published in 1846–47, only a year after the discovery of the Warren Mastodon, is found the following quaint narrative of the succession of discoveries in Orange County, and an interesting reflection of the scientific opinions of the middle of the nineteenth century.

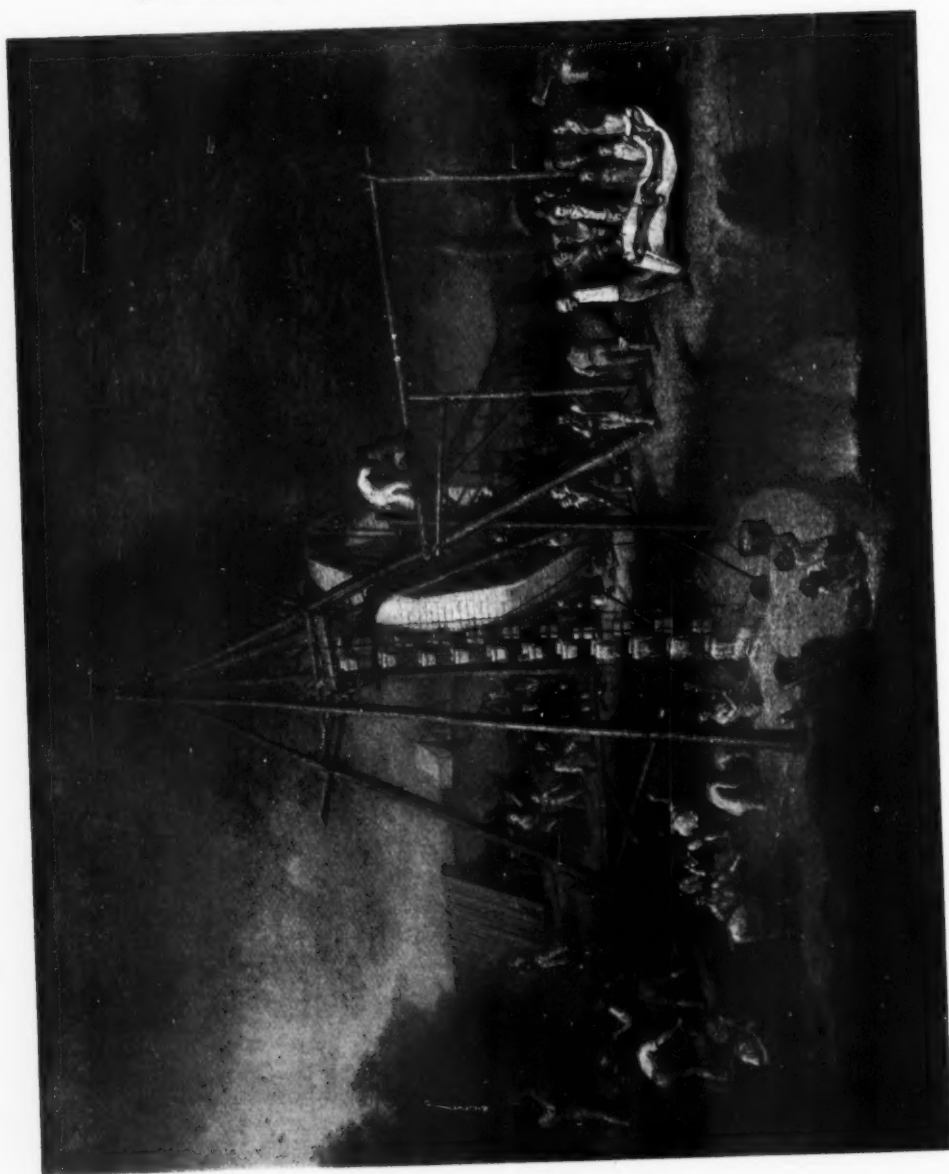
"We cannot, without disrespect to the memory of a lost but giant race, and slighting the widespread reputation of old Orange as the mother of the most perfect and magnificent specimens of terrestrial animals, omit to tell of the mastodon. Contemplating his remains as exhumed from their resting place for unknown ages, we instinctively think of his great and lordly mastery over the

# EXCAVATION OF THE PEALE MASTODON

In 1799 there was discovered on the farm of John Masten, near Newburg, New York, the skeleton known as Peale's first mastodon. The exhumation of this skeleton, portrayed in the painting, was carried on in the year 1801. The principal figure in the foreground is Dr. Charles Willson Peale. The other two figures assisting him in holding the scroll are probably Titian and Rembrandt Peale.

This photograph shows at work twenty-one men and two boys of the twenty-six who were engaged under the direction of Doctor Peale. The elaborate machinery that occupies the center of the picture consists of a continuous bucket chain with a long trough. It was designed by an ingenious millwright to keep the excavation free of water. A number of the male onlookers and even some of the workmen wear tall beaver hats as part of the quaint dress of the period. The whole scene, painted after the manner of other scientific portraits of the day, is a delightful reminiscence of the country life along the Hudson one hundred twenty years ago.

(After photograph of the painting by Rembrandt Peale, belonging to Mrs. Bertha White, now deposited in the Museum of Fine Arts, Boston, Massachusetts. Photograph loaned by Mr. H. E. Thompson)



beasts—of his majestic tread as he strode these valleys and hill-tops—of his anger when excited to fury—stamping the earth till trembling beneath his feet—snuffing the wind with disdain, and uttering his wrath in tones of thunder,—and the mind quails beneath the oppressive grandeur of the thought, and we feel as if driven along by the violence of a tornado. When the pressure of contemplation has subsided and we recover from the blast, we move along and ponder on the time when the mastodon lived,—when and how he died, and the nature of the catastrophe that extinguished the race; and the mind again becomes bewildered and lost in the uncertainty of the cause. Speculation is at fault, and our thoughts wander about among the possible accidents and physical agents which might have worked the sudden or lingering death of this line of terrestrial monarchs.

“Upon these subjects, wrapt in the deep mystery of many ages, we have no fixed or well-considered theory; and if we had, the limits of our paper would forbid us to argue it up before our readers, and argue down all hostile ones. But we may briefly enquire, whether the cause of the death and utter annihilation of the race, was one great overwhelming flood which submerged the earth and swept down these animals as they peacefully and unsuspectingly wandered over the plains and hills around us. Or was it some earthquake convulsion, full of sudden wrath, which tore up its strong foundations and buried this race among the uplifted and subsiding mass of ruins; or was it some unusual storm, black with fury and terrible as the tornado, which swept the wide borders of these grounds, and carried tree and rock and living mastodon in one unbroken stream to a common grave, or was it the common fate of nations, men and every race of created animals of water, land or air, which overtook and laid the giants low? that by the physical law of their nature, the decree of heaven, the race started into being—grew up to physical perfection—and having fulfilled the purpose assigned by their

creation, by a decrease slow, but sure as their increase, degenerated in number, and gradually died away and became extinct. Or was it some malignant distemper, fatal as the Egyptian murrain, which attacked the herd in every locality of this wide domain—sending its burning poison to their very vitals—forcing them to allay an insatiate thirst and seek relief in the water ponds around them, and there drank, and drank, and died? Or was it rather, as is the general belief in this community, that individual accident, numerous as the race, befell each one, and in the throes of extrication sank deep and deeper still in the soft and miry beds where we now find their bones reposing?

“We have thus briefly laid before our readers all the causes which we have heard assigned for this remarkable, ancient, and wide-spread catastrophe, and leave them to the speculation of others, while we wait for time and the developments of geology to uncover the cause.

“But when did these animals live and when did they perish, are questions equally wrapt in profound mystery, and can be answered only when the true cause of their death is found. In the meantime we ask, were they pre-Adamites, and did they graze upon the fields of Orange and bask in the sunlight of that early period of the globe?—or were they antediluvian, and carried to a common grave by the deluge of the Scriptures?—or were they postdiluvian only, and till very recent periods wandered over our hills and fed in these valleys; and that now some wandering lord of the race, an exile from the land of his birth on the banks of the great father of waters, is gone in silence and melancholy grandeur to lay himself down and die in the yet unexplored regions of the continent? On the points of vital interest in solving the great question of time and mode of death, we hazard no conjecture. Among geologists the opinion is fast gaining ground, that the epoch of the appearance of the mastodon on earth was about the middle of the tertiary period,—and that he was here ages before

man was created,—that before that epoch warm-blooded terrestrial animals had not appeared. The period of their extinction is thought to be more doubtful, but probably was just before the creation of the human race.—Geologists think there is no evidence sufficient to establish the fact that man and the mastodon were contemporary.—Time and further investigation may explain the mystery.<sup>1</sup>

#### WHEN FIRST FOUND

"The remains of the mastodon were first found in this State, near Albany, probably as early as 1705, as appears from the letter of Gov. Dudley to the Rev. Cotton Mather, of July 10, 1706—a copy of which is furnished and worth reading.<sup>2</sup> The accounts which state it to have been in 1712 are erroneous—taking, probably the date of Cotton Mather's letter (of that date) upon this subject to Dr. Woodward, as the date of the finding. They were next found by Longueil, a French officer, on the Ohio River, in 1739. In 1740 large quantities were found at Big Bone Lick, in Kentucky, carried to France and there called the "Animal of the Ohio." Since which many have been found in various parts of the Union.

"No locality,<sup>3</sup> except the Big Bone Lick, has contained a greater number of these remains than Orange County. The first were discovered in 1782, about three miles south of the village of Montgomery, on the farm now owned by Mr. Foster Smith. These bones were visited by Gen. Washington and other officers of the army while encamped at Newburgh in 1782-3. The Rev. Robert Annan, who then owned the farm, made a publication at the time, describing the bones, locality, etc., which caused Mr. Peale subsequently to visit this county.

"In 1794 they were found about five miles west of the village of Mont-

gomery, just east of the residence of Archibald Crawford, Esq., and near the line of the Cocheton turnpike. In 1800 they were found about seven miles northeast from Montgomery, on or near the farm of Dr. George Graham. In 1803, found one mile east of Montgomery, on the farm now owned by Dr. Charles Fowler. These were the bones dug out by Mr. Peale of Philadelphia, in 1805 or 6,—and the writer, then a boy at school in the village, saw the work in progress from day to day. In 1838 a tooth was found by Mr. Daniel Embler, of Newburgh, on or near the farm of Samuel Dixon, Esq., of that town. In 1844, found eight miles southwest from Montgomery, on the farm of Mr. Conner, near Scotchtown, in Wallkill. In 1845, found about seven miles east of Montgomery, on the farm of Nathaniel Brewster, Esq.; and, in the same year, on the farm of Jesse C. Cleve, Esq., in Hamptonburgh, about twelve miles southeast of Montgomery. They were also found in the town of Goshen some years since, but the time and locality we do not know. There have been at least a dozen findings of these bones in the County. From these enumerations it would appear as if the village of Montgomery was the center of the circle of these various findings.

"The animal [the skeleton found on the farm of Nathaniel Brewster and subsequently known as the Warren Mastodon] was supposed to be of great age—judging from the length and size of the tusks, and from the fact that some bones, which in young animals are separate, in this had grown firmly together.

#### POSITION OF THE BONES WHEN FOUND

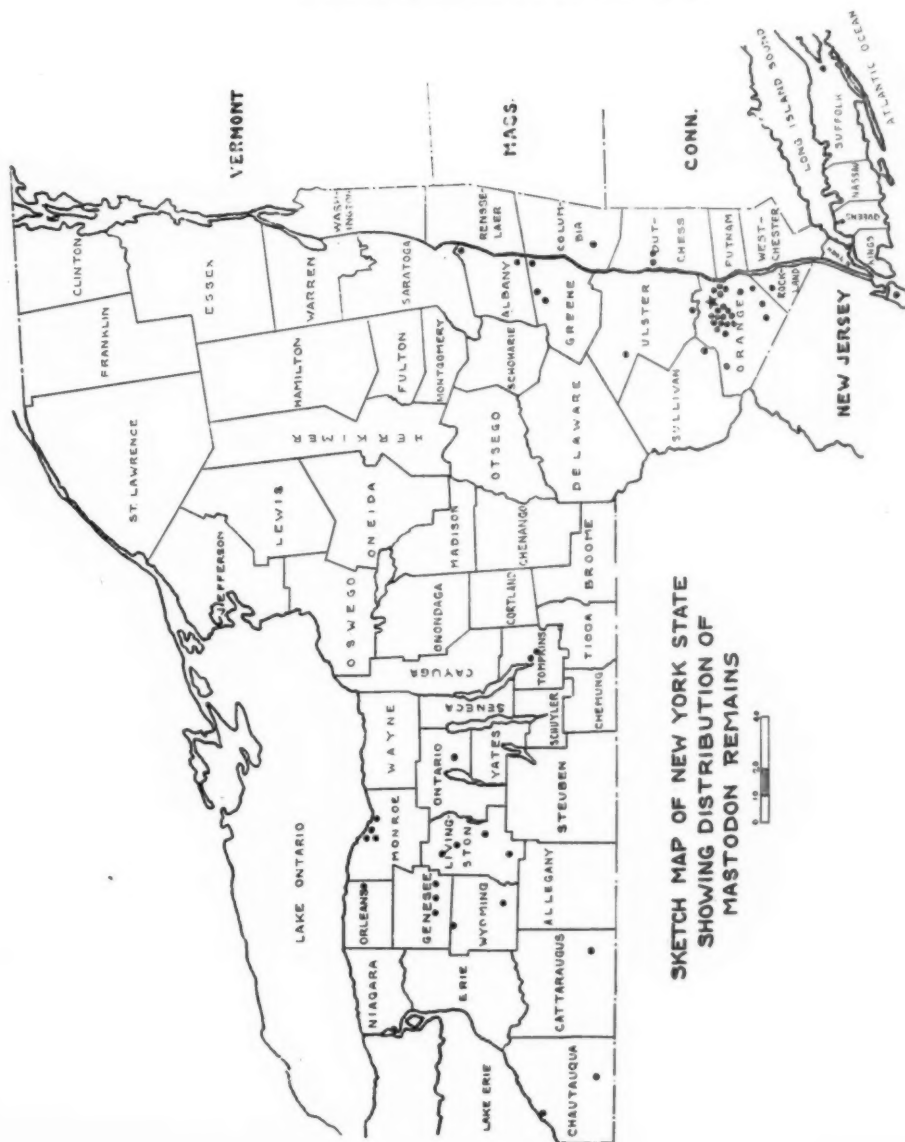
"Having measured the giant, let us inspect the place where found, uncover his resting place and observe his position in death. Mr. Brewster was digging out marl, and his workmen came upon the skeleton, every bone of which they succeeded in exhuming. Though wanting some of the toes of the fore-foot, we believe they were found and carried away in the pockets of some of the early visitors. Like all others

<sup>1</sup>The reader is referred to an article entitled "Did the Indian Know the Mastodon?" by Jay L. B. Taylor, *NATURAL HISTORY*, 1921, pp. 591-97; also to the article by William B. Scott "On American Elephant Myths," *Scribner's Magazine*, 1887, p. 469.

<sup>2</sup>This letter is not reproduced in the present article.  
<sup>3</sup>Remains indicating 300 animals were found at Kimmewick, Missouri.

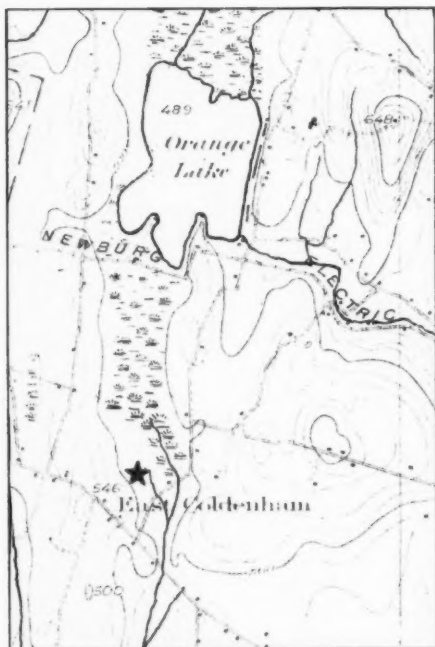
# DISCOVERY SITES OF MASTODONS IN NEW YORK

This map, taken from that which appears in the article entitled "Mastodons of New York," by Dr. John M. Clarke (New York State Museum, *Bulletin* 69, published 1903) shows, by the concentration of the dots just north of the Hudson River Highlands in Orange County, how numerous are the mastodon remains in that area. The site where the Warren Mastodon was discovered—formerly known as the Nathaniel Brewster Farm but now called the Sycamore Farm—is indicated on the map by a star



SKETCH MAP OF NEW YORK STATE  
SHOWING DISTRIBUTION OF  
MASTODON REMAINS





The Warren Mastodon was discovered on the site marked by the star, in the valley south of Orange Lake and about two hundred yards north of the Cohecton Highway at East Coldenham. The skeleton was at first known as the Brewster Mastodon because of the fact that the farm on which the find was made was the property of one Nathaniel Brewster, a grandson and namesake of whom is now the owner of the land. Reproduced from the Newburg Quadrangle Topographical Survey, State of New York, United States Geological Survey, edition of September, 1903, reprinted September, 1910

in this County, these were found in a peat formation, but of very limited extent, between two slate ridges. They were six feet beneath the surface—yet so deep was the peat below that its bottom could not be reached with an iron rod of several feet in length. The animal was thus held in suspension, and as the spot was wet and spongy, never dry perhaps from the time he entered, it caused their perfect preservation.

“Beginning at the bottom, the following were deposits which from time to time filled up the pond:

- 1, Mud, more than ten feet,
- 2, Shell Marl, three feet,
- 3, Red Moss, one foot,
- 4, Peat, two feet.

The bones laid below No. 3 and occupied nearly the position the animal did when alive, and the whole position that of one mired. If there ever was one that came to his death in that way, this is the one.

“In Godman’s *Natural History*, article Mastodon, is recorded an instance of the same kind [the preservation of stomach contents], and puts the fact beyond all question, that the contents of the stomach of the Brewster [Warren] mastodon was found. The animal was dug up in Wythe Co., Va., and the stomach found,—the contents carefully examined, and found to be in good preservation. They consisted of reeds half masticated—of twigs of trees, and of grass or leaves.

We have made free use of the article written by Dr. A. J. Prime, of Newburgh, and found in the *American Quarterly Journal* of October, 1845, and various newspaper publications made by the same gentleman.”

Thus ends our quotation of the quaint narrative of Samuel W. Eager.

#### OTHER REMINISCENCES OF THE DISCOVERY

The American Museum is indebted to Mrs. George F. Elliott of Westfield, New Jersey, for the following reminiscence of the discovery, contained in a letter of March 21, 1906, addressed to the late J. Pierpont Morgan, the donor of the Warren collection to the American Museum. Mrs. Elliott writes:

“I was much interested on reading in this morning’s *Tribune* of your recent purchase of the American mastodon from the Warren heirs; interested firstly, because it will now be given to the public; secondly, because it was found on, or in, my grandfather’s farm in East Coldenham, six miles west of Newburgh, on the Newburgh and Cohecton turnpike. As a child I distinctly remember the excitement that prevailed in the neighborhood at the find and during the time it was on exhibition in my grandfather’s barn.



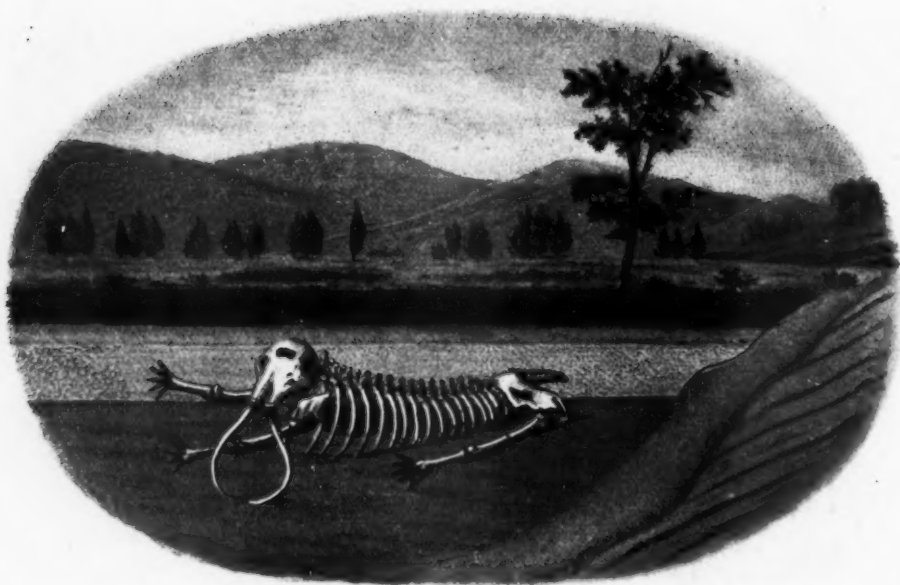
I was present at  
the original discovery  
of the Warren Mastodon  
discovered in 1875  
and assisted in the  
Exhibition of same

J. Brownell  
M. & C. Bain

Sep 2<sup>nd</sup> 1907

Mich





#### THE WARREN MASTODON IN SITU

Vignette showing the Warren Mastodon as it was stretched out when originally discovered about six miles northwest of Newburg and about one mile south of Orange Lake. The vignette, which appeared originally in color on the title page of Doctor Warren's *Mastodon Giganteus of North America*, is designed to show the succession of strata under which were found the skeletal remains. Usually all these strata were covered during the wet season with a depth of water varying from one or two feet to six or eight feet, but during the unusually dry season of 1845, the year of the discovery of the skeleton, the area had almost dried up. According to Doctor Warren, the position of the extremities shows that the animal, at the time of its destruction, was making strong efforts to extricate itself from the abyss into which it had plunged. Beneath the body and limbs is a stratum of clay but the body was embedded in light-colored shell-marl, which incased the head, the right anterior limb, spinal column, part of the ribs, pelvis, and the tail. Above the shell-marl was a layer of red moss of a pinkish color; the top layer was of dark-colored peat a foot or two in thickness; above this in ordinary seasons was the depth of water already referred to





On Saturday, August 19, 1922, the writer visited the locality where the Warren Mastodon was discovered and had the good fortune to meet Mr. Nathaniel Brewster, the grandson of the original owner and excavator of the skeleton, who with his daughter, Miss Brewster, gave the writer a most courteous reception.

Mr. Brewster pointed out the original boxes, excellently constructed, in which the skeleton was originally packed and transported from place to place for exhibition. Although a small boy at the time, being only three years of age, he distinctly recalls placing his little fist in the eye socket of the mastodon skeleton. He also recalls the spot where the mastodon was found, now buried beneath a pond of considerable size. On September 6, 1922, Mr. S. H. Chubb visited the site with his excellent camera and photographed Mr. Brewster pointing to the spot in question (see lower picture; the upper picture shows another view of the same locality). The relation of the site to its environment is shown in the map on p. 8

It was wired and set up on the premises. Doctors Warren, Hitchcock, Blackman, and Prof. Silliman were all there at times. The location where it was found was in a depression or sort of basin of marl, which they were taking out for improving the land elsewhere. The head was struck first, for the animal was standing erect, as it had sunk in the soft marsh. Even the contents of the stomach were intact, consisting of twigs as large as a man's finger, and were gathered in a bushel basket. The tusks were also perfect when found, but crumbled on coming in contact with the air. There is a brooch in the family with the head in 'profile' of one of my uncles carved on it, made from a piece of the outside of these tusks; there is also a part of a tooth that broke off after it was set up. My oldest brother, who now occupies the homestead, has much interesting data in connection with it, also an engraving of the different strata of soil in which it was found, with a cut of each separate bone, and would furnish you, no doubt, with anything of interest to you in connection with it. It was sold to Doctor Warren by my father while he had it on exhibition either in Hartford or in New Haven."

Another reminiscence is that contained in a letter received at the American Museum on August 16, 1907, from Mr. W. M. Nelson of Equinunk, Wayne County, Pennsylvania, who writes:

"So far as I know, I am the only living man today<sup>1</sup> who saw the skeleton of the animal taken from the marl pit on the farm of Nathaniel Brewster, six miles west of now Newburgh City, where the road runs north to Orange Lake. I saw the entire skeleton taken out and bones wired together by Doctor Prime, of Newburgh, in Mr. Brewster's barn. This was done in sections so it could be set up and taken down and shipped in the boxes as freight. It was on exhibition about the country by Wm.

Brewster and Clinton Weeks, son and son-in-law of Mr. Brewster.

Squire Eager's history of Orange Co., New York, gives the dimensions of the skeleton as follows: length of skeleton 33 feet; skull between eyes 2 feet, 1 inch; length of skull 3 feet, 10 inches; number of bones 220; ribs, 20 on each side. Total weight of bones, 1995 pounds. . . . The mastodon's backbone was found about 5 feet below the surface in the marl pit. Every bone was found and wired, except one toe bone, about the size of an egg. I was a boy some 16 or 18 years old at the time and took it all in. I remember nothing about Professor Warren. Doctor Prime wired the bones together and I saw him most every day at the work of setting up the skeleton. I do not know whether this history is of any interest to you now, but it will hold water, so far as my memory is concerned."

The above reminiscences may be supplemented with the account of the discovery gathered from the memoir by Doctor Warren published in 1852:

"The summer of 1845 had been unusually dry; many small lacustrine deposits were exposed by the drought, and their contents removed to fertilize the neighboring fields. The spot above described, though usually covered by a small quantity of water, had been left dry (an occurrence never known before); and Mr. Brewster, wishing to avail himself of its contents, had employed a number of laborers to remove them. The men had dug through a thickness of two feet of peat-bog, a layer of red moss about a foot thick, and then fell upon a bed of shell marl (*vide Vignette*).<sup>1</sup> After raising about a foot of this, they struck on something hard; and a question arose whether it was a rock, a bone, or some other substance. Night approaching, it was necessary to intermit their labor until the following day.

"Mr. William C. Brewster, son of the proprietor, and Mr. Weeks, his son-in-law, with assistants, in the presence of a

<sup>1</sup>Another survivor is Mr. Nathaniel Brewster, a grandson of the owner of the farm at the time of the discovery, who is shown on p. 11 pointing to the spot from which the skeleton was recovered.

<sup>1</sup>The vignette is reproduced on p. 10 of the present article.

large number of persons, neighbors and travellers, proceeded to examine the object of their curiosity. The stroke of a spade brought up a portion of bone, and everyone was then willing to believe they had discovered the last retreat of one of the ancient mastodon inhabitants. The labor of exhumation then proceeded rapidly; and the part struck was ascertained to have been the summit of the head. This, being uncovered, disclosed to the eyes of the spectators the full extent of the cranium, which was four feet in length. The lower jaw was distorted a little toward the left side. The bones of the spine, tail, pelvis, and ribs, were successively found, for the most part in their natural relation to each other. The anterior extremities were extended under and in front of the head, as if the animal had stretched out its arms in a forward direction to extricate itself from a morass, into which it had sunk. The posterior extremities were extended forward under the body. The tusks lay with their convexities outwards, their anterior extremities opposed to each other nearly meeting; and thus the two tusks, taken together, described a large part of a circle. (*Vide Vignette.*)

"At the end of the second day's labor, the whole of the skeleton had been obtained, with the exception of the posterior part of the sternum, a few bones of the feet, and a number of the caudal vertebræ, some of which were recovered afterwards. The bones were in an almost perfect state of preservation. They were not black, like most of the mastodon bones, but of a brown color, like those of a recent human skeleton, which had been in use a considerable time. It is worthy of remark, that no mastodon bones but those belonging to this individual, and no other bones excepting two or three of animals recently entrapped in the mire, were found in this deposit."<sup>1</sup>

"Doctor Prime, who was present, describes its appearance as follows:— 'In the midst of the ribs, embedded in the marl and unmixed with shells or

<sup>1</sup>*The Mastodon Giganteus of North America*, by Dr. John C. Warren, pp. 5 and 6.

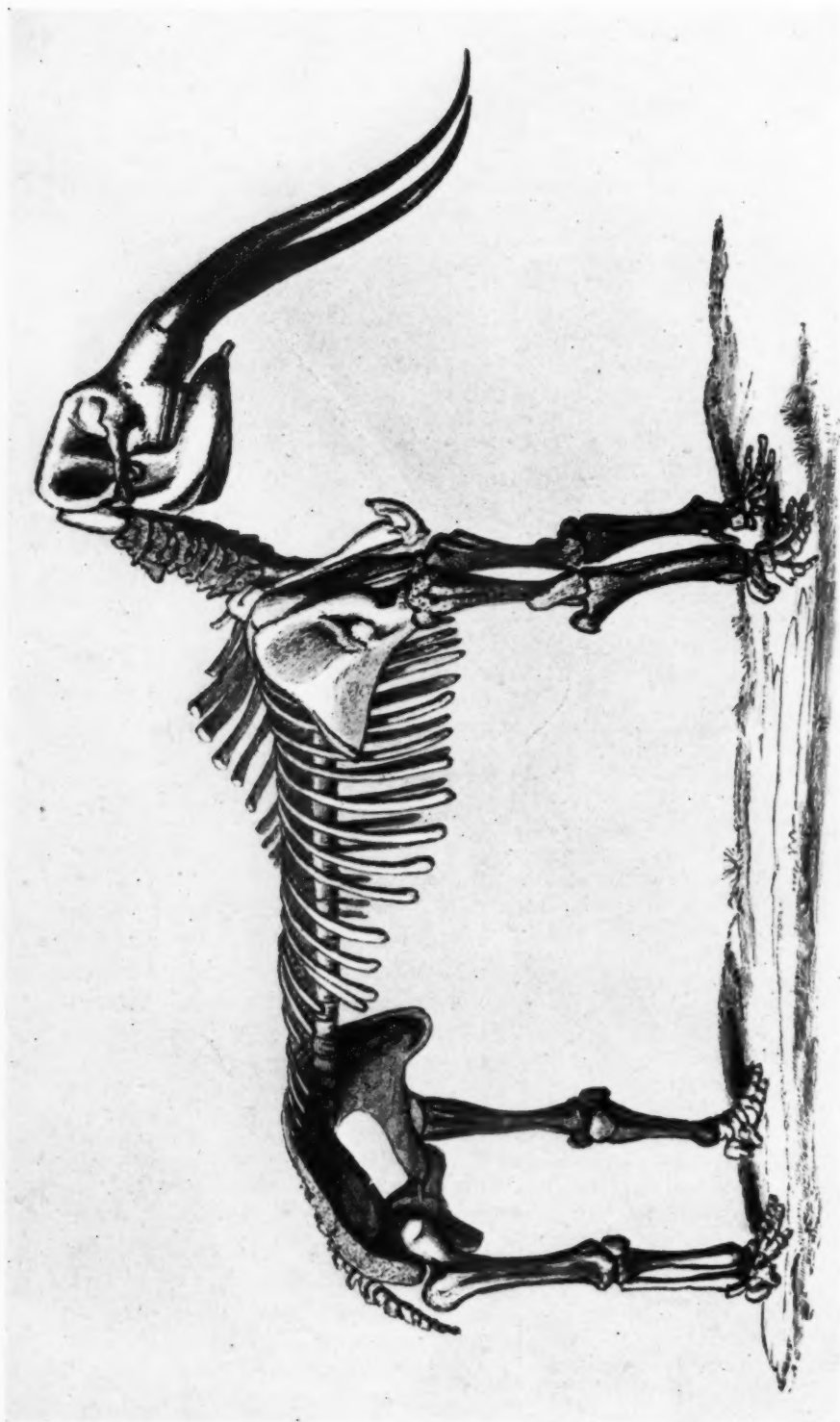
carbonate of lime, was a mass of matter, composed principally of the twigs of trees broken into pieces of about two inches in length, and varying in size from very small twigs to half an inch in diameter. There was mixed with these a large quantity of finer vegetable substance, like finely divided leaves; the whole amounting to from four to six bushels. From the appearance of this, and its situation, it was supposed to be the contents of the stomach; and this opinion was confirmed on removing the pelvis, underneath which, in the direction of the last of the intestines, was a train of the same material, about three feet in length and four inches in diameter."<sup>1</sup>

#### TOUR OF EXHIBITION

Owing to the fact that the bones were buried in a pure shell-marl layer, they were, when found, in a perfect state of preservation; of light brown tint, not of the dark brown or nearly black tint of the mastodon skeletons exhumed from swamp muck, which are discolored by decaying vegetable matter. As narrated by two eyewitnesses, the skeleton was wired together and set up in such form that it could be exhibited for three or four months during the years 1845 and 1846, in the city of New York and in several New York and New England towns. Luckily, it does not appear that any of the parts were lost during this period of exhibition and travel.

The excellently made boxes in which the skeleton of the Warren Mastodon was transported from point to point for exhibition still remain in the possession of Mr. Nathaniel Brewster. The impression which the mastodon made on observers in the city of New York is shown by an extract from the journal of one of the pupils of the New York Institute for the Deaf and Dumb, October 16, 1845:

<sup>1</sup>*Idem.*, p. 144.



THE WARREN MASTODON AS IT WAS MOUNTED SHORTLY AFTER ITS DISCOVERY

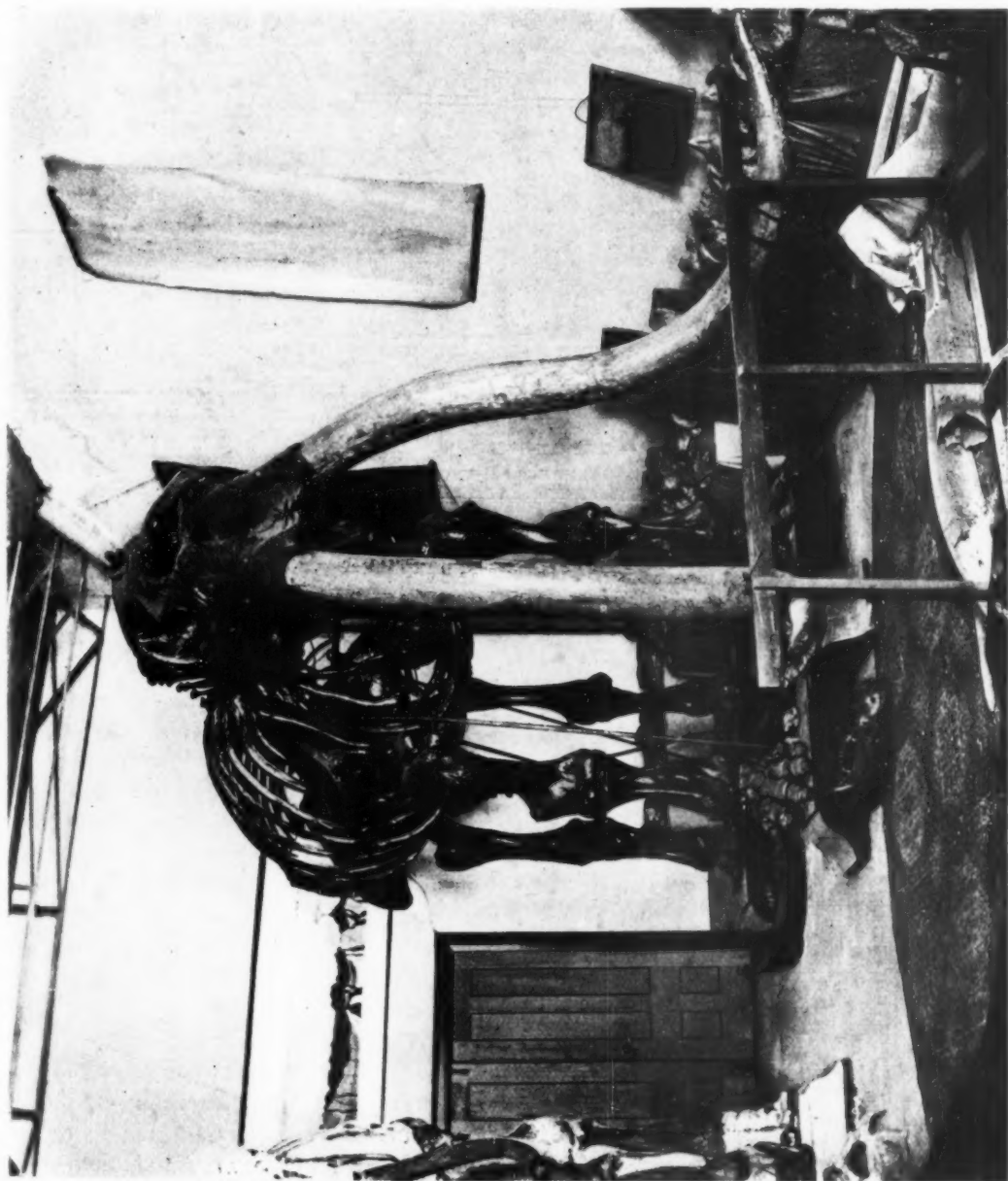
The figure is reproduced from the *American Journal of Agriculture and Science*, Volume II, Number 2, conducted by E. Emmons, Albany, and A. J. Prime, Newburg. In their article, "The Great American Mastodon," Messrs. Emmons and Prime remark: "The skeleton has since been arranged and set up, and this has been done with great care and the strictest attention to the articulating surfaces of all the bones, which we believe has not been the case with others which have been put together."

THE WARREN MASTODON  
AS REMOUNTED IN 1849

For fifty-seven years, that is from 1849-1906, the Warren Mastodon, remounted as shown in the picture, was exhibited in the Warren Museum in Boston. In 1906 it was acquired, thanks to the generosity of the late J. Pierpont Morgan, by the American Museum.

The skeleton, as here depicted, is covered with heavy black varnish. The imitation tusks are made of papier-maché and were so lengthened as to sweep the ground and curve outwards at the extremities. The chest and backbone were raised two feet above the top of the shoulder blade, or scapula, and as a result the natural height of the animal was increased from nine feet to twelve feet. Beneath the Warren Mastodon are tusks and grinding teeth of other specimens. [Around the base of the walls are many vertebrae of the giant *Zeuglodon*, the archaic fossil whale of southern United States.]

As I photographed in the interior of the Warren Museum, 92 Chestnut Street, Boston





"Having been kindly invited by the proprietors of this wonderful exhibition, we went up into the Minerva Rooms, 406 Broadway, and looked at the American Mastodon, one of the greatest curiosities in the world, according to my imagination. We steadily gazed at it with much astonishment. The bones of it are articulated together or fastened to each other by iron nails so as to form a skeleton, and it is now exhibited in this city. Two long artificial tusks measuring ten and a half feet in length are fixed into the skull; the old tusks of nature are almost corrupted, and it is said that they were found entire in the skull when first discovered, but they have fallen in pieces so that they cannot be made fast. The large vertebræ of its spine or backbone gradually increase in size from the extremity of the tail to the head. We could stand below the long ribs. We examined the legs and bony toes with great curiosity. The whole bones weigh 2002 pounds but they must have weighed 20,000 pounds when it was living. The skeleton measures 29 feet in length, and the height of its head, 12 feet, that of its back, 10 feet, and the width of the pelvis, 6 feet.

"The skeleton, which has been brought to this city for a show, was found in a marl bed on a farm at Newburgh, of New York. I am very proud of that skeleton first discovered in this state.

"It is supposed that this animal on walking along the marl bed, sunk into it by its legs adhering closely to the marl and it was drowned. It remained in it for a long time. Previous to the discovery, nobody knew the place where it was buried. We should be thankful to the proprietors who found it and took great pains to fix the bones firmly into a skeleton. What a wonderful success!! It leads us to admire the power and wisdom of our Almighty Maker who made the largest of animals."

#### DOCTOR WARREN ACQUIRES THE MASTODON

Fortunate was its purchase in 1846 by Dr. John Collins Warren, professor of anatomy in the Harvard Medical

School, who paid \$5000 for it. Doctor Warren, who about this time became president of the Boston Society of Natural History, had the skeleton transferred to Boston, where it was mounted under his direction by Dr. N. B. Shurtleff; this was its second mounting. It was exhibited to Sir Charles Lyell, the distinguished English geologist, who made a tour of the United States during the years 1841-45; also to Professor Jeffries Wyman, founder of the Museum of Comparative Anatomy, Harvard Medical School; also to Professor Louis Agassiz, who was called to Harvard University in the year 1848.

The teeth of the mastodon had been known in America since 1705 and in Europe ever since Longueil, a French officer, brought them back from the banks of the Ohio River in 1739; they had been examined and described by the great French naturalist of the period, Buffon; they had been assigned the specific name of *Elephas americanus* by the American naturalist, Kerr, in 1792; they had been falsely confused with those of the woolly mammoth of Siberia by Blumenbach, who gave this animal the name of *Mammut*; they had finally, in 1806, been properly christened 'mastodonte' by the great French naturalist, Cuvier; yet the actual structure and proportions of the mastodon still remained unknown. Consequently the discovery and mounting of the Warren Mastodon skeleton was a really great event in the science of palæontology; it rendered possible for the first time a knowledge of the complete animal. It appears, however, that Doctor Warren was not satisfied with the mounting by Doctor Shurtleff, nor with the security of the building where the skeleton was first exhibited in Boston, because in 1849 the masto-

don was remounted by Mr. Ogden under Doctor Warren's direction and placed with other collections in the especially erected fireproof building at 92 Chestnut Street, Boston, which soon became famous as the Warren Museum. It was at this time that the skeleton received its coat of black varnish, was raised two feet above its natural height, and was provided with the enormous pair of papier-mâché tusks.

From 1849 to 1906 the skeleton remained in the Warren Museum in the condition shown in our photograph on page 15. Professor Warren became intensely interested in adding to his museum other specimens of the mastodon, especially those discovered along the west bank of the Hudson River, and also in securing specimens from England, France, and Germany, for purposes of comparison. Thus his collection was enriched by the acquisition of the superb head of an old bull mastodon found near the Shawangunk Mountains, and hence known as the Shawangunk head; this is one of the largest, if not the largest, bull mastodon head ever found. Through active correspondence with Professor Jean Jacques Kaup, Doctor Warren secured casts of all the specimens that Professor Kaup had discovered near Eppelsheim not far from Worms in Germany, namely, *Mastodon longirostris* (signifying long-jawed mastodon) and *Dinotherium giganteum* (signifying the terrifying giant beast), animals which at the time aroused the wonder of Europe. Thus there were soon gathered in the Warren Museum numerous specimens from different parts of the world—North America, Europe, and Asia—bearing on the history of the proboscidean order. Doctor Warren devoted his spare time for six years to the study of

these animals, and in 1852 issued a splendid monograph entitled *The Mastodon Giganteus of North America*. In April, 1908, the autograph copy of this precious publication, with marginal annotations in Doctor Warren's handwriting, was presented to the Osborn Library of the American Museum, together with *The Life of John Collins Warren, M.D.*, in two volumes, by Dr. Edward Warren.

#### REMOVAL TO THE AMERICAN MUSEUM

The writer of the present article had for years longed to secure this famous specimen for the American Museum but never dreamed that it would be possible to obtain it. It appeared that the entire Warren collection was entailed in the will of Doctor Warren and that the heirs were not at liberty to dispose of it until the decease of the last of the immediate descendants. The writer was greatly surprised, therefore, when he received a letter from Dr. Thomas Dwight of the faculty of the Harvard Medical School, indicating that the entail was at last closed and that the collection might be offered for sale under certain conditions. This letter came on a Friday afternoon and the writer left the same evening for Boston, arriving in Doctor Dwight's study on Saturday morning; he accompanied this distinguished anatomist to the old Warren Museum on Chestnut Street to view the famous skeleton for the first time. The black varnish appeared to present an obstacle, but some vigorous scratching with a pen-knife revealed the rich light-brown color of the bone beneath. A friendly interchange of opinions with Doctor Dwight ensued; a valuation was agreed upon for the entire collection, but there was still little thought in the writer's mind that it could be secured by the

American Museum. On the Monday following, the prince of museum benefactors, Mr. J. Pierpont Morgan, authorized by telephone an offer of \$30,000. This offer was immediately accepted and a few days later Dr. William Diller Matthew went to Boston to pack up the entire Warren collection, covered as it was with a half century of Boston dust. The collection was carefully inventoried, and with it came several valuable photographs and pictures, which are reproduced in the present article.

#### THE FOURTH MOUNTING OF THE WARREN MASTODON

In removal all the original framework was left in Boston, only the bones being packed; in this separated condition the precious skeleton, covered with its thick coat of black varnish, reached New York, its native State, in safety. The first question which arose in our minds was whether it would be possible to remove the black varnish; this was answered through a series of experiments which resulted in the construction of special vats large enough to contain the longest and broadest bones, such as the thigh bones, the hip girdle, and the skull. Many weeks of immersion in pure benzine were necessary before the black varnish began to dissolve. This treatment was followed by vigorous scrubbing with pure spirits of alcohol, and one by one the bones emerged from this prolonged and very expensive bath in all the purity and beauty of color that characterized the skeleton when it was exhumed by Doctor Prime in 1845.

There still remained the problem of the tusks, which are invariably the most vital part of buried skeletons of the great proboscideans of the past. It appears that the original tusks could

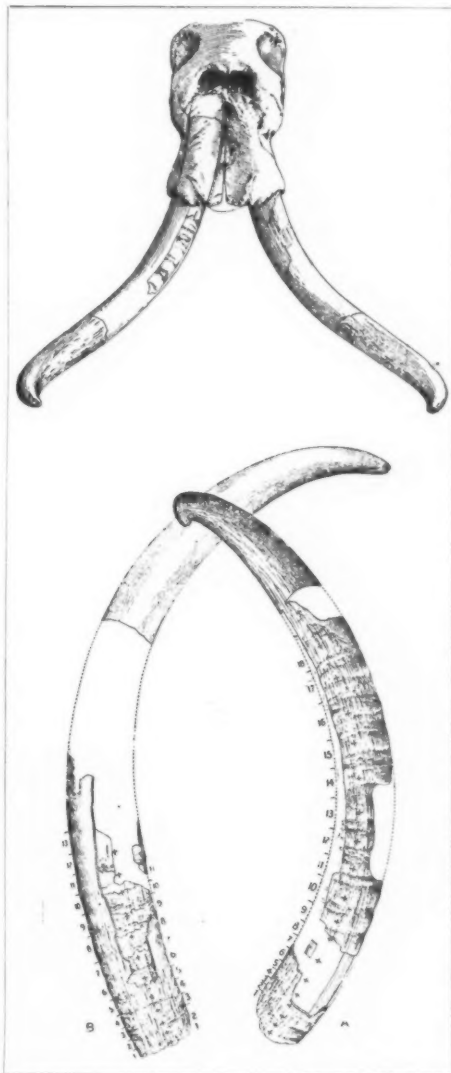
not be preserved entire by the methods then known. The discoverers were unable to prevent them from splitting, warping, and falling to pieces, especially at the butt. In order to preserve what could be saved intact, the butts of the tusks, already hopelessly split and warped, were sawed off under Doctor Warren's direction, and only the tips, about three feet in length, were treated and preserved. The butts, fallen into fragments, but still lying undisturbed in two of the original boxes used for transporting the skeleton, were found in the Warren Museum when the skeleton was repacked to be sent to the American Museum. The tips, treated with preservatives, were still intact in another box; but neither had been used apparently for measurements in making the papier-maché restorations fitted to the skull in the Warren Museum. This documentary evidence certainly was not used by Professor Warren, because in his three restorations he unfortunately accepted the erroneous original reports that the tusks as found were more than eleven feet in length; they were so described and illustrated by him in the entirely impossible position shown in the photograph on p. 15.

When the Warren collection reached the American Museum, it was very carefully looked over in a search for remnants of the original tusks, and finally the fragmentary fossil ivory was found, but inasmuch as most of the original records had been lost and no use of these materials had been made by Doctor Warren, it remained to be proved that the fragmentary butts of the tusks really belonged with the skull. The piecing together of these butts required several months of most ingenious and patient work on the part of one of our preparators, Mr. Charles



Christman. The ends of each tusk were perfectly preserved, but there was no connection between these tips and the reconstructed butts of either tusk. Fortunately, when the butts of the tusks were sawed off, a single splinter of bone broke off, and finally this splinter was found to fit exactly to a fragment of the butt. There was great rejoicing in the laboratory when the relationship of these two fragments was discovered, because it enabled us to determine positively the length of the tusks as 8 feet, 7 inches.

The rebuilding of the tusks, which required several months of most patient work, had two very important results: in the first place, it enabled us to place them properly in the sockets of the skull and to prove for the first time the exact relations of the mastodon ivories; secondly, a very painstaking examination of these tusks led to an important and most interesting discovery, namely, that it was possible to determine very closely the age of the Warren Mastodon. The ivory exhibits a series of growth rings which, counted from tip to base, seems to prove that the Warren Mastodon was perhaps thirty years of age at the time it sank into the bed of marl near Newburg. The right tusk included at least twenty-eight of these segments. The growth rings are shortest near the tip of the tusk when the animal is young, and increase in length from the tip toward the middle of the tusk, but not in a regular ratio. These growth rings do not correspond exactly in the opposite tusk, but in both tusks they are longest in the middle region. Nine smaller rings are in the lower part. The writer's theory regarding these growth rings is that during the summer season, when all the conditions of life were favorable, and



In repairing the tusks of the Warren Mastodon, it was found that the outer sheathing of the ivory (dentine) was in large part absent; the inner sheathing exposed a series of concentric constrictions and expansions which were observed to be approximately symmetrical on the two sides, as indicated by the two series of + signs in the lower figure. In the second place, it was noted that the intervals between these constrictions are broader in the middle stages of the growth of the tusk and narrower in the mature or later stages of its growth. On the hypothesis that these are actual annual increments of growth, the right tusk (A) consisted of about twenty-eight segments, which, allowing for the period of milk teeth and for the part worn off at the tip, would assign to the Warren Mastodon an age of perhaps thirty years.



THE WARREN MASTODON AS REMOUNTED IN THE AMERICAN MUSEUM IN 1908

The skeleton is so complete that the only restorations or replacements which have been necessary are the following: caudal vertebrae 1-14, 16-28; all the terminal phalanges of the left forefoot except digit iii; and phalanx 2, digit iv, of the right forefoot. The following bones are introduced from other individuals: two posterior sternal bones, phalanx 2 on digits ii, iii, and v

MEASUREMENTS OF THE WARREN MASTODON

	Feet	Meters
Length, base of tusks to drop of tail	14 ft. 11 in.	4.55
Height to top of spines of back at the shoulders	9 ft. 2 in.	2.80
Tusks: Length of right tusk, on outside curve	8 ft. 6 in.	2.59
Length of tusk exposed	7 ft. 4 in.	2.14
Thigh bones: Length of right	3 ft. 5 in.	1.05
Length of left	3 ft. 6½ in.	1.08
Pelvis or innominate bones: width	6 ft.	1.83



MODEL OF THE WARREN MASTODON BY CHARLES R. KNIGHT

This reconstruction made by Mr. Knight under the direction of Prof. Henry Fairfield Osborn, 1912-14, is one of a series of models of the extinct and living elephants, and of the mastodons, made to a uniform scale of  $1\frac{1}{2}$  inches to the foot, or a  $\frac{1}{8}$  scale. The heights of these animals in descending order are as follows:

Imperial mammoth, *Elephas imperator*,  
African elephant, *Loxodonta africana*,  
Indian elephant, *Elephas indicus*,  
Jeffersonian mammoth, *Elephas jeffersoni*,  
Woolly mammoth, *Elephas primigenius*,  
American mastodon, *Mastodon americanus*,  
Pigmy African elephant, *Loxodonta pumilio*.

13 feet, 6 inches, record of Rowland Ward  
11 feet,  $8\frac{1}{4}$  inches, record of Rowland Ward  
10 feet, 6 inches, type specimen, American Museum  
10 feet, 6 inches, type specimen of western Europe  
9 feet, 6 inches, as measured from the Warren Mastodon  
9 feet, 2 inches, height of specimen in the New York Zoological Park  
6 feet, 2 inches, height of specimen in the New York Zoological Park



GROUP OF AMERICAN MASTODONS ALONG THE MISSOURI RIVER IN KANSAS

This restoration was made by Mr. Charles R. Knight, in 1920, under the direction of Prof. Henry Fairfield Osborn. There are two mastodon bulls, a cow, and a calf in the scene

# "THE COHOES MASTODON" AS HE APPEARED IN LIFE

This restoration is based on the most careful study of the muscular anatomy and proportions of the animal as derived from exact measurements of the skeleton, aided by comparison with the external form, skin texture, and other details in living elephants. The American mastodon had a coat of hair which somewhat resembled the hair of present-day elephants, though very much thicker and longer. The animal was thus adapted to the low temperature which prevailed in this region at the breaking-up of the Ice Age. It was a very distinctive member of the New York fauna of a few thousand years ago when mastodons may have roamed the swampy regions in herds comparable in number to those of the buffalo on the western plains fifty years ago. Parts of more than one hundred skeletons have been discovered in this state. This is the only life-size scientific restoration that has been made of the American mastodon.

Executed, under the direction of Dr. John M. Clarke, by Messrs. Noah T. Clarke and Charles P. Heidenrich for the State Museum at Albany in 1921-22





perhaps during the rutting period, when tusk growth was hastened by internal secretions from the reproductive glands, the growth of ivory was very rapid, the maximum growth in the 17-18 ring being 108 centimeters, or  $4\frac{1}{4}$  inches, perhaps the maximum growth of a favorable season at the most vigorous reproductive period of life. The Warren Mastodon is an adult but not an aged specimen; the skeleton is apparently that of a younger animal than the one represented by the Shawangunk head. Some estimate the maximum age of the American mastodon at between thirty and forty years,—less than half the life span of the elephant, which attains more than one hundred years.

It was very important to make another correction in mounting this animal, namely, to ascertain its exact height at the shoulders. The temptation of preparators has always been to make both mastodons and elephants much larger than they actually were in life by raising the chest portion high above the tips of the shoulder blades. In order to determine this much-mooted question, our preparator at the time, Mr. Adam Hermann, spent a day on the back of Gunda, then the favorite riding elephant of the Zoological Park; placing his two thumbs on the tip of the spine and his two index fingers on the tip of the shoulder blades,

he was able to note that the shoulder blades are on practically the same level as the summit of the spine. This observation enabled us to determine positively that the height of the backbone of the Warren Mastodon at the tip of the spine is 9 feet, 2 inches above the ground, whereas the length of the animal from the skull measured at the very base of the tusks to the droop of the tail is 14 feet, 11 inches, practically 15 feet. Thus the length of the animal's body is 6 feet, 9 inches greater than its height at the withers. Its proportions are thus totally different from those of any species of elephant. The long, low body is correspondingly broad, with an immense spread of six feet across the hips or pelvis. It is to emphasize the long, low, and broad proportions of the American mastodon, that the accompanying restorations were made by Charles R. Knight, under the writer's direction.

The reader who is interested to learn more about this subject is referred to works by Warren and others in the Osborn Library of the American Museum of Natural History, and especially to an article by Dr. John M. Clarke entitled "Mastodons of New York. A List of Discoveries of Their Remains, 1705-1902," in the Report of the State Paleontologist, 1902, New York State Museum, Bulletin, 69, p. 921.

# Primitive Fishery Methods in Lake Titicaca

By R. E. COKER

Professor of Zoology, University of North Carolina

HIGH in the Andes, at a level only about two thousand feet lower than the top of Pike's Peak, lies a large body of water nearly one third the size of Lake Erie. This is appropriately termed by Neveu-Lemaire,<sup>1</sup> "the most remarkable sheet of water on the globe." Through it passes the boundary line of Peru and Bolivia. Since the Chile-Peruvian war of 1879-83, Bolivia, the ally of Peru in that struggle, has enjoyed no seaport, and until recently had no direct railway outlet to the coast. Her import and export trade was conducted mainly by boat across the lake from the Bolivian port of Huaqui to the Peruvian port of Puno, where there was a railway connecting with Mollendo on the sea. So important was this commerce that enterprising capitalists found it practicable to have large lake steamers constructed in "knock-down" form and conveyed by ships and rail to Puno, where they were assembled and launched. Thus we find large and well equipped modern steamers plying the waters of Titicaca in company with the crude reed craft, or balsa, of a type that may have been in use for thousands of years.

The importance of Titicaca is not a recent development. Before the Spanish conquest the earlier civilization was centered in this basin, and the islands and shores of Titicaca were thronged with cities or villages. Though the fish life in the lake is limited, it is probable that fishing has

been pursued by the methods now in use for many centuries, perhaps for milleniums.

Lake Titicaca is in the center of its own plateau basin, which is without connection with either the Atlantic or Pacific drainage. Around it, in fact, are some of the highest peaks of the continent, rising above twenty thousand feet. The lake proper has generally precipitous shores and its greatest depth is barely more than nine hundred feet.

Both the plant and the animal life in the lake are remarkably limited in variety, but the bays and marshy regions are richly supplied with the few native forms.<sup>2</sup> About ten species of fish, three of Amphibia, scarcely more than twenty of small Crustacea, and a very few of small mollusks, sponges, aquatic insects, and parasites have been discovered, all of which are found almost exclusively in the shallow bays or close to the shore. Only two genera of fishes are represented in the lake: *Trichomycterus*, including small catfish known as "suchi" or "bagre," and *Orestias*, a genus of top minnows, peculiar to high altitudes. The fishes are all small, but they occur in great abundance in the bays and several of them are most delicate and palatable as food.

The fishermen near Puno are the native Aymará Peruvians, primitive in their customs and, apparently, harboring a deep-rooted suspicion of the whites; those of the pueblo of Chimú, though living within sight of the capital

<sup>1</sup>Neveu-Lemaire, M. *Les Lacs des Hauts Plateaux de l'Amérique du Sud* (Mission scientifique, G. de Créqui Montfort et E. Sénéchal de la Grange) 197 pp., XVIII Pls., 41 text figs. Paris, 1906.

<sup>2</sup>Coker, R. E. "Lake Titicaca—The most remarkable lake of the world," pp. 174-182. *Internationale Revue*, Band IV. Leipzig, 1911.



The fishing device shown in this picture is known as the *caincha*. It consists of two converging fences of *tolora* reeds that protrude above the water, and a framework (*cupo*) holding a net that is fitted into the point of the incomplete V.

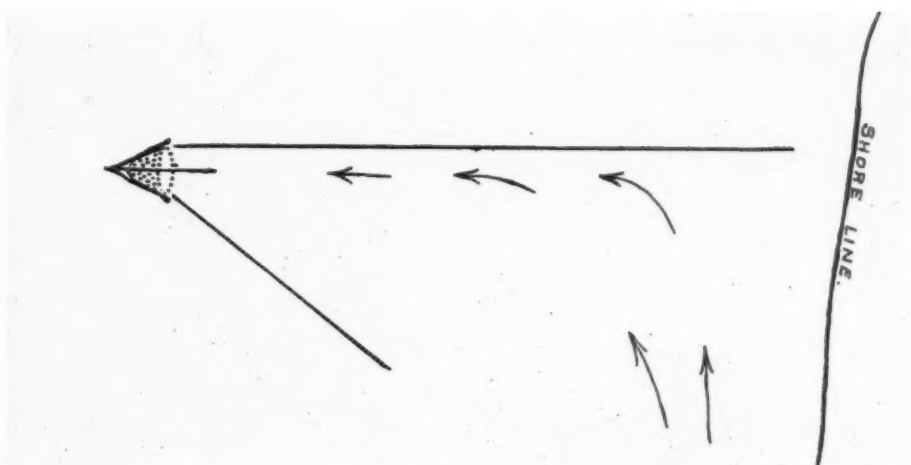
On the shore in the background is a village. Some of the huts, close to the base of the mountain, may be distinctly seen; others are higher up on the rocky wall

of the Department at Puno, seem entirely unacquainted with the Spanish language. The few that I talked with through an interpreter, on the occasion of a brief visit several years ago, refused persistently to give information or to part with a piece of apparatus I desired, even though I offered a pecuniary reward in advance. At the suggestion of a gentleman from Puno, I forced a coin into the unwilling hand of a native, with a surprising but gratifying effect that prompted me to repeat the experiment. The recipient of a coin would bring out and deliver a desired article or answer questions freely, but only until the worth of the coin was exhausted; it was, therefore, necessary to renew the donation at intervals during the conversation. It must be

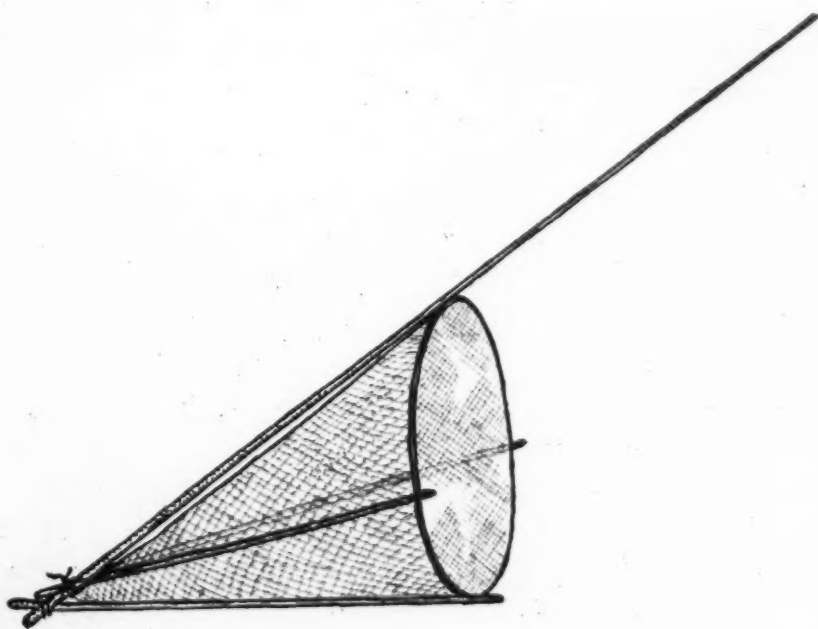
left to the ethnologist to explain this remarkable combination of an obstinate unwillingness to bargain with a determination to give for value received a fair return—and no more.

The best contrivances for taking fish are the *caincha* and the *ccana*, as the pound and the dragnet are known in the native Aymará language. The *caincha* is an interesting sort of pound, composed of two fences of *tolora* (a bulrush) and a net attached to a conical frame. To form the fences the *tolora* reeds are placed side by side and fastened together at the bottom by a line woven among the reeds. When in use, the line is securely staked to the bottom, while the buoyancy of the reeds holds them in a vertical position. In the trap observed, the longer fence was





A diagram, from a field sketch by the author, of a *caincha*, with the *cupo* in place at the point of convergence of the sides of the *caincha*. The arrows indicate the direction of the movement of the fish from the time of its entry into the fenced area until its capture in the *cupo*



The *cupo* (with net) used to take fish that have been induced to swim into it by the weir of the *caincha*. The diagram was prepared by J. V. Greene from field sketches by the author. According to the recollection of the author the hoop of the *cupo* was between ten and fifteen feet in diameter

set nearly at right angles to the beach, while the other, which was much shorter, was placed at the outer end in such a way that the two fences constituted a sort of funnel with a long and a short side. Thus a simple weir was formed: the fish, swimming along the shore, would pass the shorter barrier but would be turned outward on encountering the long arm of the weir, which reached nearly to the shore, and would thus be directed into the small opening between the two fences.

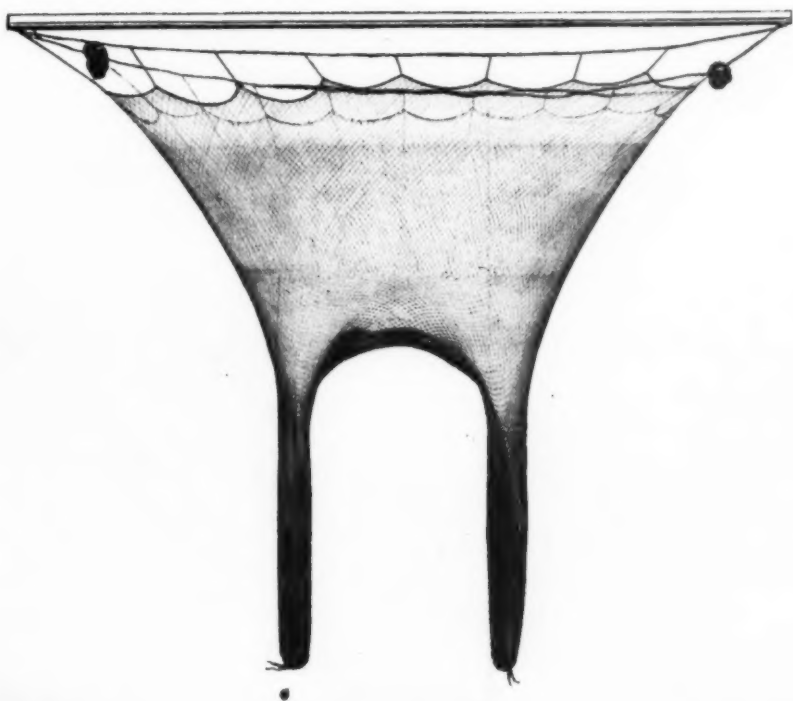
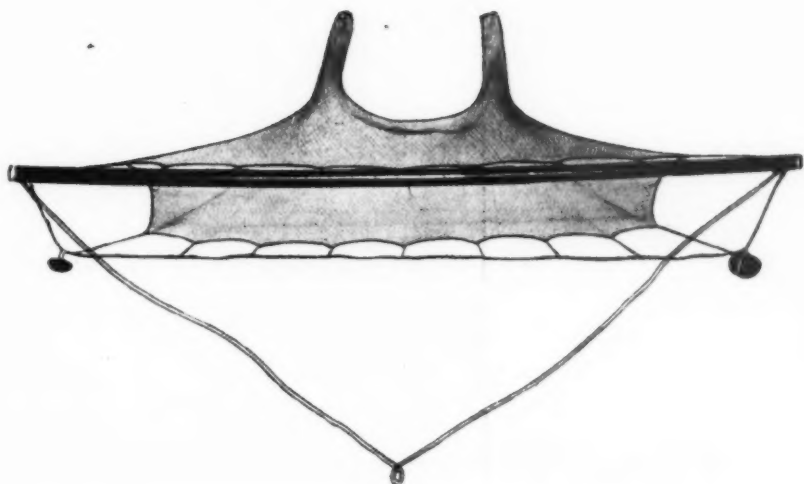
The net used to cover the opening of the trap is primitive and peculiar. It is not in evidence at all in the photographic illustration, but is diagrammatically represented in the sketch on the opposing page. It consists of a deep bag net hung from a very large wooden hoop secured to a long pole. The ring stands out at right angles to the pole, being supported by three smaller braces, which extend from the base of the main pole to different parts of the circumference of the hoop. With the pole in vertical position, the ring or circular mouth of the net is horizontal, but, if the pole be allowed to fall, the mouth of the net may be made to fit against the opening of the trap. After a suitable interval the pole is raised to a vertical position; the fish may then be removed from the net, and the trap again lowered for another catch. While suggesting a pound net when seen from the surface of the water, the *caincha* is essentially a simple combination of a weir and a dip net. The operation is carried on from balsas, which are moored by strong lines that extend out in various directions from the mouth of the pound and are permanently anchored with heavy stones; a single buoy from one of these mooring lines may be seen in the right foreground of the illustration on

p. 26. The frame of the net (*cana*) is called a *cupo*.

One of the interesting nets used by the indigenous fishermen in this lake is the *ccana*—the spelling here adopted reproduces as nearly as possible the pronunciation of the Aymará word, beginning with the sound of hard *c*, repeated without the intermediation of a vowel sound. The *ccana* is a sort of trawl net which is dragged on the bottom, and may be used either near the shore or, as my informant said through an interpreter, "where the bottom can not be seen." It is dragged from balsas for "bogás" and "suchis." The net has a large mouth kept open by a cross pole, on which its top is stretched, and by stones attached to the lower edge of the circumference. The net does not taper backward to a single cod end, but possesses the striking feature of being extended behind by two rather long and slender cylindrical bags, in which apparently the fish are practically trapped. In form and use it is essentially a primitive beam trawl with features of a trap. Either the indigenous Peruvians have not learned to complete the frame of the trawl or else they have found that the apparatus served more effectively without such support. The net collapses, of course, when brought into a vertical position. The *ccana* examined and made the subject of the accompanying illustrations<sup>1</sup> was 2.2 meters long, with a mouth 6 meters in circumference, the opening being about 2½ meters (8 feet) in width.

The *uisi-cibiña* is a dip net with a long handle that may be pushed ahead

<sup>1</sup>The illustrations are retouched photographs of a net obtained by the writer at Chimu and now deposited, by courtesy of the Davenport Academy of Sciences, in the American Museum of Natural History. The net was staged in Washington for photographing, but nothing was added to the apparatus except the beam.



The *ccana* is a trawl net In the upper picture it is shown in position for use; in the lower picture it is pendent



These marshes, or *totorales*, of the Bay of Puno, Lake Titicaca, abound in small fish and Crustacea



The picturesque reed craft, or balsa, of Lake Titicaca is the representative of a type antedating the discovery of America

on the bottom. Dr. Garman<sup>1</sup> has described the use of this net as follows: "Armed with this the Indian glides back and forth along the beach late in the evening, when the hungry siluroids [catfishes, or suchis] come close to the water's edge to feed, occasionally dropping the net quietly down so as to cut off its retreat and then with a jerk throwing an unwary fish far out of the water. It is said that these nets are also used in fishing by torchlight from balsas."

My informant described a sort of trap that I was unable to see. It was evidently identical with the trap which Garman described in the following words: "The pot is a short cylinder of open basket-work with one end rounded and closed, and with a gate in the other, like that of the lobster pot, which admits the fishes but prevents their egress. Considerable ingenuity is displayed in the structure of these baskets. The warp is of single stems of a smooth, stiff, wiry grass; the woof is made by wrapping several small stems with split straws, making rolls which are bound to the stems of the warp, on the outside, by passing one of the straws which bind the roll around each stem at the proper distance from each other. The spaces in the warp are determined by the size of the fishes desired; those in the woof by the strength of the materials. Such traps are used as are lobster pots."

Another form of apparatus described by native fishermen is a trap of mats of

*titora* rushes which is dragged in the water on the beaches; the trap is closed as it is hauled on to the beach. A method of fishing mentioned by other writers involves the use of a three-pointed spear attached to the end of a steering paddle; in the very transparent water of this lake in the skies the fish may be distinguished at a depth of fifteen feet or more. I could not by inquiry learn of the use of a casting net or of any form of hook, and these implements seemed not to be known to the indigenous fishermen of that locality, although the fishhook, at least, formed a part of the tackle of the autochthonous Peruvians of other parts. The native vegetable poisons, generally called *barbasco*, are used to stupefy fishes, especially in sluggish rivers, or in artificial *pozos*, or pools, excavated along the margins of the rivers.

The picturesque floating craft, the balsas, of Lake Titicaca are well known. Two large bundles of *titora* rushes, five or six meters in length, bound tightly and secured together, constitute the body of the craft, while slender bundles laid above these and attached to the outer margins form the sides. The balsas are propelled by paddle or sail, the sails being made also of *titora* rushes woven together in somewhat the fashion of a Venetian blind.

The fishery of today in Titicaca is but a relic of that which must have existed there when the greatest civilization of the American continent centered about its shores; yet the methods now employed are doubtless the same as were practiced in Inca and pre-Inca times.

<sup>1</sup>Agassiz, Alexander and Garman, S. W., "Exploration of Lake Titicaca." *Bulletin of the Museum of Comparative Zoölogy at Harvard College*, in Cambridge, Vol. III, No. 11 (1. Fishes and Reptiles, by S. W. Garman, pp. 273-278). Cambridge, Massachusetts, 1876.



A LESSER NODDY OF OENO-ISLAND

At the time when the Whitney Expedition visited Oeno, the lesser noddies were just through nesting, but the young bird here shown was not quite able to fly and so was forced to sit for its portrait



# The Voyage of the "France"

A LATER-DAY TRIP TO THE SCENE OF THE "BOUNTY" MUTINY  
AND TO OTHER ISLANDS OF THE SOUTH PACIFIC

BY ROLLO H. BECK

Leader of the Whitney South Sea Expedition

AFTER being dependent for more than a year on local trading vessels that call irregularly at many of the Polynesian islands for cargoes of copra, we came to the conclusion that the work of collecting birds could be done far more quickly and thoroughly if the Whitney South Sea Expedition had a vessel of its own. Several schooners were offered at prices beyond their value but finally one better than I had hoped for was brought to my attention, and a cable to the American Museum resulted in its purchase.<sup>1</sup> While the name "France" was not so typically local as "Anapoto," "Tamorre Moorea," or "Vahini Tahiti," the designations of other craft that were in the market, the vessel itself excelled them all in its seaworthiness and it offered the further advantage of probable exemption from heavy repair bills in the near future. With a change in the arrangement of the cabin and the addition of a few shelves and a table in the hold, the "France" was ready for sea, though before turning her over to the American Museum, the owners found it necessary to replace the rudder and rudder box, which had been damaged by shipworms<sup>2</sup> during a year's use in the Marquesas, where facilities for painting and cleaning the bottom had not been available.

As the hurricane season was in full swing when we were ready to leave on our initial cruise, it was deemed advisable to run south out of the track of

possible storms and then work out to the easternmost end of the cluster of islands that are included under the term Polynesia. Ravaivai Island, our first stop, three hundred miles southeast of Tahiti, yielded several specimens of wedge-tailed shearwaters (*Puffinus pacificus*) and gray ternlets (*Procelsterna cinerea*), desirable species



An ancient stone figure hidden away in a forest on Ravaivai Island

that we had not found on our first visit the year before, while Rapa Island, five hundred miles south of Ravaivai, gave us a fine series of white-breasted petrels (*Fregetta grallaria*) and their eggs. At Rapa we were surprised to see several of the Christmas Island

<sup>1</sup>See NATURAL HISTORY, January-February, 1922, p. 88.

<sup>2</sup>See NATURAL HISTORY, July-August, 1922, pp. 378-79.

shearwaters (*Puffinus nativitatis*), which were captured by means of steel traps placed in burrows where young birds were located. We had not observed this species since leaving the vicinity of Christmas Island, more than 1500 miles to the north, but a few days later at Bass Rocks, 40 miles to the south of Rapa, we again noted it. Rapa also yielded a couple of dozen additional specimens of the wary little black rails (*Porzanaidea* sp.?) which we had heard often at Tahiti and Moorea, but which on those islands kept so securely hidden in the thick grass and ferns that a capture was very seldom accomplished. At Rapa these birds feed largely in the cultivated taro beds where the small snails that figure in their diet are abundant.

Our especial desideratum at Rapa was a large bluish shearwater, two specimens of which we had obtained the year before, but we found none on this occasion. At Bass Rocks, however, only an hour's flight away, this bird was the predominant species and we collected as many specimens of it as we needed, lying off in our small boat to the leeward of the Rocks. Here we secured also a couple of specimens of another small shearwater not met with elsewhere, and were greatly interested in noting the absence of the white-breasted petrel and the neglected petrel (*Pterodroma neglecta*), two common species of oceanic birds that are found on Rapa near by, the shores of which can be easily discerned from Bass Rocks. On account of a strong wind and a rough sea we found it impossible to land on the precipitous rocks, a half dozen of which, scattered over a couple of miles of ocean, form the group collectively termed Bass Rocks. Our inability to land prevented us from obtaining a series of sooty terns which

we wanted, for an adult and a couple of young birds, brought down from high in the air, apparently belonged to a larger variety than the Christmas Island birds that we had caught by hand when visiting that locality. After five hours in the small boat off Bass Rocks we returned aboard the "France" and headed eastward, favored by a fair wind that carried us a hundred fifty miles before it petered out.

For the next two weeks we had light winds most of the time but on the twelfth of March, thirteen days after leaving Bass Rocks, Pitcairn Island appeared on the horizon and we neared the landing place simultaneously with a large English steamer that was bound for New Zealand. Three boats loaded with natives and island produce immediately drew alongside the steamer, which stopped for an hour before resuming its course, whereupon the natives, who had sold their melons, corn, and chickens, came to our craft, and several of them who had known members of our crew in Papeete, stepped aboard to renew acquaintance. Permission to collect having been granted by the governor, our small boat was lowered, and we went ashore in company with the descendants of the famous mutineers of the ship "Bounty," who settled on Pitcairn in 1790 and were not heard of for forty years. At the end of that time an American ship touching at the island discovered them in place of the seals, that were the object of search. These mutineers married native women but their descendants show very little of Polynesian strain in their ancestry.

Since the opening of the Panama Canal, steamers on their way from England to New Zealand frequently stop at Pitcairn to exchange clothing



Bass Rocks, jutting sharply up out of the water about forty miles from Rapa Island, are far less dangerous to ships than the lowly coral atolls a few hundred miles to the northward



The principal occupation of the men of Rapa Island is to sit on a rock several hours a day, holding a fishing pole until a mess of fish has been captured. The old pilot of Ahurei Bay, pictured above, had cushioned his seat with a few handfuls of long coarse grass gathered near by



THE NEST OF THE WHITE-BREADED PETREL

Many of the nests of this species on Rapa Island were found under thick bunches of dry grass and in such cases it was necessary to enlarge the entrance before a picture could be taken



A YOUNG FRIGATE BIRD ON TENARARO ISLAND

With beak wide open it awaits eagerly the return of its parent carrying freshly captured fish. Although the mother bird is not shown in the picture, the attitude of the young betrays her proximity





The neglected petrel on Ducie Island was usually found nesting close by the trunk or large limb of a fallen tree



The petrels of Ducie Island had begun nesting only a short time before the Whitney Expedition visited this locality, but long search revealed one or two young birds of the short-billed species and one of these is reproduced above



and foodstuffs for the island produce. Potatoes, watermelons, and corn of very good quality were in season when we called in March, and a little later in the year oranges are a source of considerable income. We bought twenty chickens at the rate of a shilling and a half each and exchanged some rice for water, which was conveyed to the landing place in wheelbarrows from a spring on the far side of the island, a distance of more than a mile. A little warbler (*Conopoderas raughni*) was the only land bird present and the larger sea birds were conspicuous by their absence, as they have been hunted for food since the settlement of the island 130 years ago.

A couple of days' collecting at Pitcairn sufficed and we left for Ducie Island, an uninhabited atoll several degrees farther east. Ducie proved a collecting field *par excellence* for red-tailed tropic birds (*Phaëthon rubricaudus*), as well as for neglected and for short-billed petrels (*Pterodroma parvirostris*) as all three were nesting on top of the ground and we had merely to walk or crawl about under the low bushes and trees to gather all the specimens we wanted. At Juan Fernandez Island, of Robinson Crusoe fame, off Chile, I had been able to find a few eggs of the neglected petrel on narrow ledges along the high cliffs, and at Christmas Island the short-billed shearwaters nested usually under the concealing dead palm leaves, as did the Christmas Island shearwaters, a few of which still lingered at Ducie, although their nesting season had long passed. Out of a dozen species of shearwaters, the eggs of which I had collected during the last twenty years, these three were the only kinds that nested on top of the ground, the remainder being burrowing birds. But instead of occasional

nests, which had been my usual experience, at Ducie there were literally hundreds, each containing but one egg, and we believe that 30,000 would be a very conservative estimate of the breeding Tubinares. Every afternoon about four o'clock the space above the trees reminded one of the front of a beehive on a warm spring day in prune-blossom time in California, for thousands of birds would circle overhead, chasing one another and dropping to the ground to waddle along to the spot selected for a nest. Before the egg was laid both birds were present at the nest, but after it was deposited only one bird was to be found on guard. The tropic birds, many with pink-colored feathers, hollowed out nests in the sand under the bushes along the outer edge of the wooded part of the island, for their legs were poorly adapted to walking, whereas the shearwaters would traverse a hundred yards, if necessary, to gain an open place before taking wing. Many of the latter surprised me by climbing up sloping tree trunks into the tips of the branches in order to take their plunge into the air.

The most astounding nesting habit observed was that of the fairy tern (*Leucanous albus*) in placing its single egg on top of a narrow limb with no trace of a nest, and hatching it in that precarious position. That this bird really survives the perils of infancy is evidenced in nearly every island by the abundance of the species.

At Ducie we started eating freely of the fish that are easily caught on and near the reef, until the cook and mate were laid up in bed and several other members of the party complained of not feeling well, and then fishing was tabu till we reached Henderson Island. After proving to our satisfaction that

the Henderson fish were not poisonous, we salted and dried several hundred pounds, with such good results that when we sampled our store, it was found as palatable as the Alaska salmon, with which we were well supplied.

In the way of birds Henderson yielded a rail, a dove, and a warbler, as well as the usual sea birds, but travel over

they chose to remain close by the landing place till our departure. Future visitors should have less trouble than we cutting trails through the tangled vines and shrubbery if the goats use their freedom to good advantage in nibbling their way to the interior.

Four days after leaving Henderson we arrived at Oeno Island, which has



In the Tuamotu Islands the single egg of the fairy tern is usually laid on a branch of the tohunu tree. No nest is constructed, the egg being placed in this hazardous position without other support than that furnished by the limb itself

this island proved so difficult that most of our collecting was necessarily done near shore. As Henderson is a raised coral island instead of being of the usual low atoll type, the surface of hard coral rock is broken in places by sharp, jagged, pinnacle-pointed masses that are far more difficult to traverse than the reefs over which we made our way before stepping on to the sandy beach above high-water mark. The last three of the ten goats purchased for food in Rapa we liberated on Henderson, but

proved one of the most deadly islands of Polynesia in point of shipwrecks, for it lies close to the track of sailing vessels bound from the Pacific coast of North America to the west coast of South America and, having an extended reef off the eastern end, is doubly dangerous. The shores of the low atoll were lined with weather-worn lumber from one of the latest wrecks, and the keel of one large vessel still lies on a sandy islet a mile within the lagoon, with an anchor stock showing

on the reef, where an attempt had been made to stop the headway of the doomed ship. We found on Oeno that some of the blue-faced boobies (*Sula dactylatra*) were wiser than most of their kind on other islands, for they had selected the shade of a tree or bush for a nesting site, whereas the glaring white beach is the usual home site selected by this species.

In addition to the Ducie Island shearwaters we encountered again the blue shearwaters that had been so common at Bass Rocks. But instead of high cliffs on which to build their nests, as at Bass Rocks, at Oeno there was only a low fern-covered flat a dozen feet above the sea level. Many sea birds were resident here, and a week slipped by in short order. The last day of our stay our sailors were caught in the breakers on the reef and their boat was overturned by an extra large swell. The schooner had stood out to sea on a short tack and the crew were obliged to remain in the water more than three hours till the ship made her inward tack. By good fortune not a shark approached them, though at other islands the sharks had kept us close company.

Mangareva, the seat of government for the eastern Tuamotu, was a pleasant change from the desert islands to the eastward, and with its neighbors, all within the same reef, kept us busy for more than two weeks. That there had been a much greater population at an earlier date is evidenced by the old, crumbling stone houses encountered everywhere about the shores. Although there are now only about 500 people in the Gambier group, as the five inhabited islands are called, about 19,000 formerly lived there. A convent that housed hundreds of girls in years past is today covered by the growths of

the encroaching jungle and will soon be a thing of memory only. The cathedral is handsomely decorated about the altar with thousands of pearl shells and is larger in appearance than the cathedral at Papeete, though the congregation does not remotely rival that of Papeete in numbers. On one of the small uninhabited islands where goats were kept, the surprising capture of a rail was made. There was hardly any cover on the island for a bird with the ordinary habits of the rails as we knew them in Polynesia, but a few had managed to exist in spite of the destruction of vegetation. On Mangareva itself we obtained a fair series of the yellow-billed tropic bird (*Phaethon lepturus*), a species that nests in the mountains in preference to the coral atolls favored by the red-tailed.

The day before we left the Gambier group the sailors gathered a few boxes of oranges and lemons, which were given us for the picking, as they were going to waste under the trees. The lemons were placed in dry sand and kept in good condition until we reached Papeete nearly two months later, but the oranges did not keep so well and were disposed of in less than a month.

Marutea Island was the next place visited and here the native sandpiper (*Aechmorrhynchus parvirostris*) was found on several motus, little islets on the ring of coral. A northerly wind that started before we left Mangareva made boating difficult, and one of the workers on the island, while helping to launch our boat in a heavy swell, was knocked unconscious and would have drowned had not a companion dived after him and pulled him from the water to the boat, which had just escaped from a curling breaker. The plantation on this island was provided with several carts used ordinarily in



On many of the Pacific islands the *Pandanus* is one of the commonest trees. Thick groves occur in many places but not infrequently single trees stand out from their neighbors and especially is this the case along the shore. Note the curious prop roots that are massed about the lower part of the stem

the picking of coconuts and in transferring the copra from the drying ground to the warehouse. We landed our small sailboat one morning and carted it in one of these conveyances across the island to the lagoon, where we used it in exploring the farther end of the atoll. At Turei Island, a few days later, we sold this boat, which was not particularly suited to our needs, to a native whose own boat had been wrecked.

The four islands of the Acteon group, fifty miles to the westward of Marutea, varied greatly in their bird life, although in regard to food and living conditions they seemed to be similar. Not one of these islands was inhabited, although our chart lists them as populated by hostile people. Tenararo, the smallest and most western of the group, had birds in abundance, and on one occasion when stopping in the course of a stroll, I counted fourteen of the little sandpipers sitting on a dead tree close beside me. As a rule any sandpiper that observed us walking in its direction would fly to meet us, being in this respect different from most of the other birds we encountered. At Tearunga and Vahanga, but a few miles to the eastward, the sandpipers and doves were very scarce, and we spent only a couple of weeks in this vicinity, sailing thence to Vanavana Island.

Here we were pleasantly surprised to find the ground doves (*Gallicolumba pectoralis*) in large numbers but extremely concentrated in one clearing where coconut trees had been grown. After the larger trees had been chopped down the vines and weeds quickly overran the place and the doves found it so much to their liking that they abandoned the undisturbed forest and congregated in a spot only a few hundred yards in radius. The island is not more than two miles in circumference and more than a third of it is bare of cover, so the doves have a slim chance of holding their own if the dozen inhabitants continue clearing the jungle and killing the birds for food. Eight months had elapsed since a vessel had called, and fish, birds, and the fruit of the *Pandanus* had been the sole means of sustenance available to the islanders for some time.

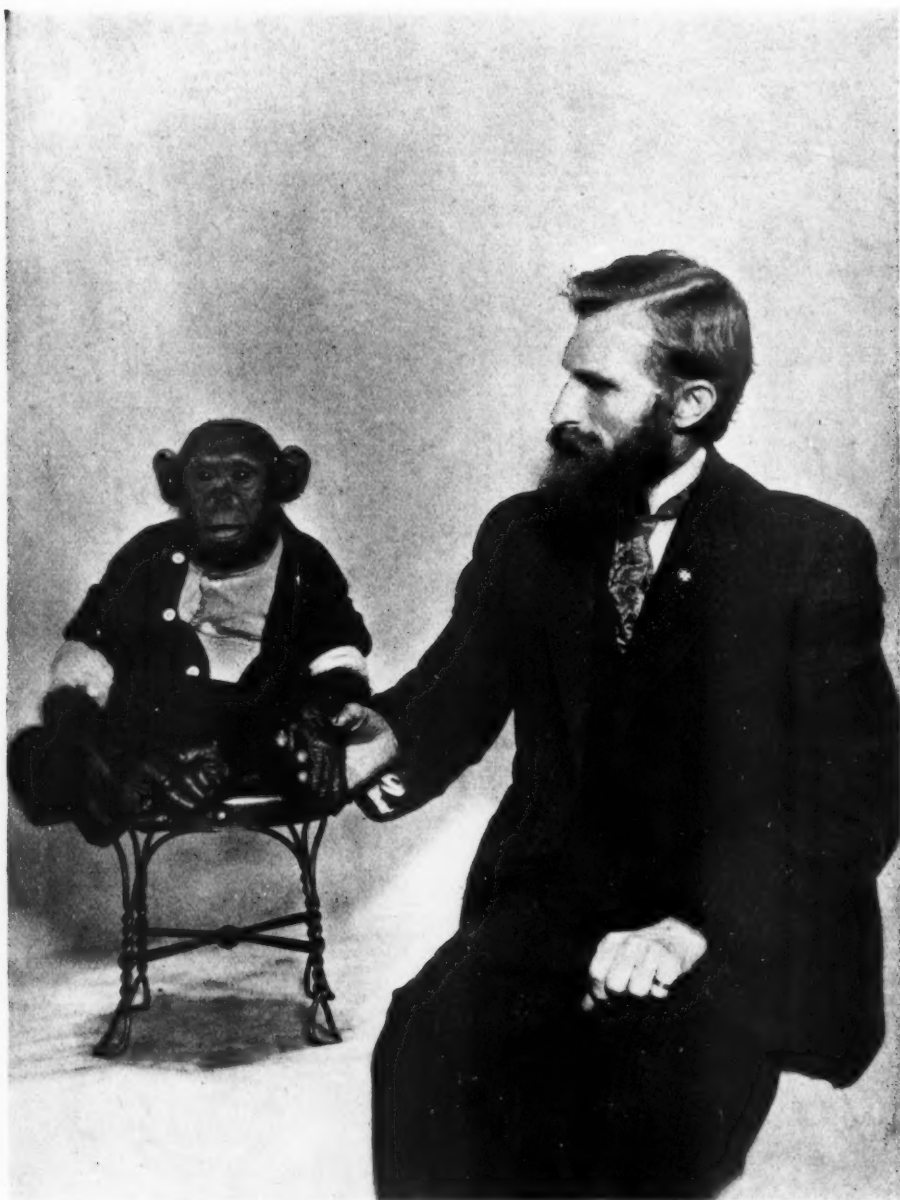
At Tureia Island, about forty miles from Vanavana, we found a small settlement of pleasant people, with an obliging priest who spoke excellent English and who was slowly repairing his hurricane-wrecked church. At this island we encountered the warbler again, our last specimen having been taken at Henderson, six hundred miles to the eastward. Why the intervening islands were devoid of this bird is puzzling, for these islands are equally suitable apparently as a habitat; it is reported that Mangareva at least was not without the warbler formerly. But the distribution of the avian fauna is puzzling with respect to other species as well.

After working over Ahunui and Paraoa, a hundred miles westward of Tureia Island, I went ashore at Nengo Nengo Island, our last stop before starting for Papeete. There I strolled into a colony of nesting frigate birds, as I had done on twenty islands in the past twenty years, but instead of the species that had inhabited the twenty—some of them west and some of them east of Nengo Nengo—I was delighted to find at last the long-looked-for lesser frigate bird (*Fregata ariel*). A colony of a hundred pairs were nesting on low shrubs, most of them not more than a

couple of feet above the ground, and I had no difficulty in getting a dozen birds for specimens, though they were not as tame as the majority of the other species when at their nests. In this colony I saw but a single bird with immature plumage. The males of the lesser frigate birds are recognizable at a long distance by the two white patches on the abdomen. In higher shrubs about the frigate colony were many old nests of noddy terns, and sitting on the ground near them, the young noddies that had been unapt at their fishing lessons were waiting for their parents to bring fish, but most of them had had long waits, judging by the very poor condition that those collected exhibited.

With a favoring wind we bore away from Nengo Nengo for Papeete and arrived inside the pass at that port a few minutes after midnight on the morning of the Fourth of July, having visited more than twenty islands on the five months' trip, over half of which had never been trodden by a collector before. After painting and cleaning the vessel and getting a fresh stock of provisions we headed out to the eastward to visit other unknown atolls and secure before their extermination examples of their dwindling fauna.





MR. W. HENRY SHEAK AND HIS PET CHIMPANZEE, JOE

Joe showed a high degree of intelligence. He learned, among other things, to wipe his nose with a handkerchief, to brush his hair with a hairbrush, to clean his clothes with a whisk broom, and to eat with a spoon as well as any little boy or girl. In carpentering he was not inexpert. He could bore holes with a brace and bit, use a handsaw with considerable skill, remove screws with a screw driver, and pound nails with a hammer



# Anthropoid Apes I Have Known

By W. HENRY SHEAK

Lecturer on Natural History Subjects

WHICH of the great apes resembles man the most? This is the question I am frequently asked. Dr. Henry Alleyne Nicholson, professor of natural history at the University of Aberdeen, asserts that "the gorilla is now regarded as the most human of the anthropoid apes." But, as a matter of fact, it is very difficult to say which is the most human, for one of them may resemble man in certain characters, while another approaches him in respect to other characters, and a third evidences close relationship to him through a third set of characters. For instance, the gibbon resembles man more than does any other ape in respect to its upright carriage. The orang-utan resembles man in the absence of the superciliary crests, prominent bony ridges which protrude out over the eyes and so disfigure the face of the gorilla, and are prominent in the chimpanzee; in the form of the cerebral hemispheres, the forehead of this ape rising straight and perpendicular from the eyes, while that of the other anthropoids retreats considerably; and in the number of ribs, there being twelve pairs as in the human skeleton, while in the gorilla and chimpanzee there are thirteen.

The gorilla resembles man more than do any of his cousins in the strength and development of the legs. He is most like man also in the structure of the pelvic bones.

The chimpanzee is most like man in the relative size of the brain and in its convolutions, though not in the finer details of brain construction; in the face, this being smaller in proportion to the size of the cranial region of the

head than in the other apes, and more human in its expression; and in the formation of the ear, which, while relatively much larger than the human ear, closely resembles it in its modeling. The large size of the chimpanzee's ear is, doubtless, due to the fact that in his native African forests the leopard is his formidable enemy and his auditory organ must be so developed that it may catch the faintest rustle of leaves made by this great stealthy cat prowling among the branches. The ear of the orang is proportionately as much smaller than the human ear, as the ear of the chimpanzee is larger. This is probably because there are no large predatory animals in Sumatra or Borneo. True, the python sometimes makes a meal of a baby ape, but the adult orang is not afraid of this monster serpent. So man is really his only dangerous enemy, and the orang has not been in conflict with civilized man, the only one who cares to capture him, a sufficient time for the association to produce any change in the anatomy of his ear. Again, the chimpanzee is most like man in the structure and conformation of the hand. The hand is very long and slender, and the thumb is set much farther back than in man, so that the distal end does not reach beyond the knuckles of the other fingers, but otherwise it is very human.

If I were asked to decide which of the apes had the larger number of close resemblances to man, I should have to cast my vote for the chimpanzee.

Of the great apes the gibbon is the most arboreal. His entire life is spent in the tree tops. In traveling through the forest, he does not come to the

ground, but swings from limb to limb by means of his long, powerful arms, using his feet very little to aid in progression. In this way he travels very rapidly, easily outdistancing the hunter, impeded as the latter generally is by dense undergrowth. Yet, notwithstanding this extreme development to an exclusively arboreal life, the gibbon, as I have already intimated, walks upright more readily and with greater ease than any other ape. I have seen the white-handed gibbon (*Hylobates lar*) in the Philadelphia Zoölogical Garden run and walk as erect in carriage as a man and without any help from his hands.

The Philadelphia Zoölogical Garden holds the world's record for keeping a gibbon alive in captivity. The specimen—the *Hylobates lar* alluded to in the previous paragraph—was received July 27, 1906, and hence has been in the collection for more than fifteen years. A record of four years and three months, attained by a gibbon in the London Zoölogical Garden, ranks second to the case just mentioned. The gibbon in the Philadelphia Zoölogical Garden has never shown much affection for his keeper, William Quigley, a man of intelligence and a close observer, who has had charge of the ape ever since the latter's arrival. Mr. Quigley tells me that it is not safe to turn one's back on this animal when in the cage with him, for he is inclined, even after all these years, to jump on a human intruder and bite him. He has never shown any of the friendliness or desire for human companionship so common with the orang-utan and the chimpanzee. Neither has he manifested any remarkable intelligence.

One of the most interesting habits of this ape is the daily utterance of a series of calls or notes, commonly

denominated "singing." They are sad and plaintive in tone, not unlike the cooing of the mourning dove, but much louder and in a higher key. On a clear, frosty morning in autumn I have heard him at a distance of more than a mile. He usually begins his "singing" about 8:30 A.M. and continues for about half an hour. On dark, gloomy days, he is more likely to "sing" at unusual times than on clear, sunny days. Once I observed he did not begin his "concert" till about 9:30 and then kept it up until nearly noontime. He has been known to sing in the late afternoon or early evening, when the day was dark, but rarely twice on the same day. The presence of people about the cage does not seem to interfere with his "singing."

Mr. Quigley says that before the death of a female *Hylobates*, which was secured at the same time as the male but which lived only about fourteen months, they both "sang," and that she was the better "singer" of the two. In closing a note she would do so with a quaver, coming down gradually to silence, while he stopped abruptly. At her death he ceased "singing," but after several months resumed the practice. I am inclined to think that these notes are the love calls of the species. I have found the gibbon always very restless while "singing," swinging from rope to rope along the top of the big cage, from one end to the other, running along the shelf in front of the window ledges, pausing for half a minute at one window, then hurrying to the other, peering longingly out, and listening, as if anxiously looking and calling for someone, and expectant of a response.

Mr. H. C. Raven, an experienced collector, and long associated with Dr. W. L. Abbott in his work in the East Indies and other regions, says that the

notes of the gibbon are among the "characteristic sounds of the Bornean forest." He tells me that in the wild, free state, both the male and the female indulge in this morning serenade.

Since the gibbon of the Philadelphia Zoölogical Garden has lived such an unusually long time in captivity, never missing a meal, and has gone for twelve years without having so much as a cold—an attack of dysentery in the summer of 1921 being his only illness in all that time—the reader may be interested to know the diet prescribed for him by the Zoölogical Society. The first thing in the morning he is given an orange and a dish of tapioca and rice, cooked together. His lunch, at half past eleven, consists of a slice of bread. Toward the end of the afternoon comes dinner, when the rice and tapioca are repeated, and a medium-sized banana and a cup of sterilized milk containing a teaspoonful of lime water is added to the bill of fare. He is never given any water to drink. This is his daily diet. It is never changed one iota. No direct current of air is ever permitted to blow on him, unless the day is warm and pleasant, but the two windows of the small mammal house which open into his cage, are arranged with double sashes, and are so adjusted that the air is always kept fresh and pure.

Frequently I have had men tell me of the interesting gorillas they saw in some traveling menagerie. On being asked how long a tail these gorillas had, the answer would almost invariably be, "fifteen to eighteen inches." As a matter of fact, no anthropoid ape has any external tail. Indeed the gorilla is a little farther removed from the tailed state than we are. In the human coccyx, which corresponds to the caudal appendage of the tailed monkeys, there are four vertebral bones,

more or less amalgamated or ankylosed. But in the gorilla there are only three of these in the normal adult. These simians, advertised as gorillas, have been baboons.

So far as I know, beyond all question, only four gorillas have ever reached America alive. The first one was brought over by Edwards Brothers in 1897. It reached Boston on Sunday, May 2, and died May 7. It was never on exhibition. Doctor Hornaday's daughter happened to be in Boston at the time and he telegraphed her to go to see the rare and interesting animal, which she did, reporting her impressions to her father. The specimen was a young male, a mere infant, and came over from Liverpool with a young female chimpanzee, to which he had become much attached on the voyage. He had been eating fairly well, but the little chimpanzee was suffering with pneumonia when they arrived, and two days later she died. After this he became listless, refused to eat, and on the fifth day after arriving he, too, died. The body was sold to Professor Burt Wilder of Cornell University, and the skin, skeleton, and brain are still on exhibition in the museum of that institution.

The second gorilla and the third were brought to the United States by the late Professor R. L. Garner for exhibition in the New York Zoological Park. The first of the two was a young female and was on exhibition in the park from September 23 to October 5, 1911, when she died. She would eat only two kinds of food, plaintains and the young stocks of plaintain and banana plants. She refused to touch bananas, oranges, grapes, bread, or any of the other articles of diet so readily eaten by the chimpanzee and the orang-utan. It was impossible to keep her alive in this

country. She measured 34 inches in height and the stretch of her arms from tip to tip of the middle fingers was 47 inches. Doctor Hornaday thought she must have been between two and three years old and Professor Garner was of the opinion that she was one of the largest gorillas ever captured, as usually the gorillas taken are small babies only a few months old.

Profiting by his first experience, Professor Garner kept his second specimen in Africa until she had learned to eat "civilized food," as Doctor Hornaday said, and in consequence they were able to keep her alive from August 24, 1914, when she reached New York, until August 3, 1915. This gorilla was named Dinah. She was of a more amiable disposition than the first specimen, ate rather freely, permitted herself to be handled and dressed in human clothes, and pushed about in a baby carriage. But the "civilized food" did not in the end agree with her. She died from starvation and malnutrition, complicated with rickets and locomotor ataxia.

The fourth instance is that of the gorilla known as John Daniel. When about three years of age, this gorilla was shipped to England and six months later came into the possession of Miss Alyse Cunningham, of London, under whose tuition he made extraordinary progress. After about two months it was possible to give him the freedom of the house. He had his place at the table, opened doors by turning the knob, and unbolted windows, raised them, lowered them again, and locked them, turned on the lights when entering a dark room, sponged himself when bathing, and adapted himself in many other ways to his urban environment. He became deeply attached to Miss Cunningham, and when later it was found necessary to sell him and he was

sent to New York, he became ill from homesickness and died before Miss Cunningham, who was summoned by cable, had time to reach him.<sup>1</sup>

The orang-utan is not nearly so good an animal for exhibition purposes as is the chimpanzee. Unlike the chimpanzee, he is not always inventing some new way to amuse himself or to accomplish some of his purposes, or engaged in mad and frantic activity. He is slow and deliberate, sedate and dignified. But though he may sit in a corner of his cage, motionless and voiceless, his bright little eyes see everything that is going on about him.

Indeed, I have found him a very keen observer. In 1907 I was traveling with the Gus Lambrigger Animal Show as naturalist and lecturer. Our star attraction was a young orang-utan. One afternoon when I was standing in front of his cage, he left his place in the farther corner, came over to the front, and, stretching his arm through the bars, put his hand on my shoulder. At first I could not imagine what was engaging his attention, but when he took his hand away I discovered there was a tiny knot in the thread of the seam of my coat, and he was trying to get it. I had not noticed it before, but his sharp eyes had seen it from the back of the cage.

Old specimens are savage and morose, but the young are gentle and affectionate, becoming much attached to their human companions. I have seen young orang-utans in the New York Zoological Park following their keeper about on the lawn, and when in sport he attempted to run away from

<sup>1</sup>For a fuller account of John Daniel the reader is referred to the article entitled "A Gorilla's Life in Civilization," by Alyse Cunningham, *Zoological Society Bulletin*, 1921, pp. 118-24. The ape, mounted in realistic attitude, is now in the American Museum. A picture of the mount appeared in *NATURAL HISTORY*, 1921, p. 655, with an accompanying note. An earlier note regarding this gorilla appeared in the same publication, 1921, p. 210.



JOHN DANIEL

This is the gorilla that, under the tuition of Miss Alyse Cunningham, of London, made such remarkable progress in adapting himself to the mode of life in a city house. The picture is reproduced by courtesy of Dr. William Hornaday, from the *Bulletin* of the New York Zoological Society, September, 1921



them, they hurried after, now and then putting their heads to the ground and turning a somersault in an effort to accelerate their speed.

One afternoon, when with the Lambrigger Animal Show, I had finished a



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This orang-utan wears, with an air of full assurance, the overalls of a laborer, and grips his pipe like an inveterate smoker. He was an animal of unusual intelligence. On one occasion, to recover a nut which had rolled beyond his reach, he took off a sweater he was wearing and, passing it through the bars, used it to draw the nut little by little toward the cage.

lecture and had sat down in a chair in front of the stage or platform on which the small portable cages were arranged. I was at some distance from the orang-utan's cage. Presently, however, I felt two hairy arms enfold my neck and a

strawberry-blond youngster climbed over on my lap and proceeded to make himself very much at home. The ape had opened the cage door himself and had walked along in front of the other cages till he was behind me. When I was with the Edwards' Animal Show in New York, we had a baby orang-utan and a big chimpanzee we called Sallie. Sallie soon learned she could frighten the little fellow by stamping her feet and screaming. One morning she started this noise, whereupon the orang-utan turned and ran to me, climbing into my lap and snuggling up to me, as if seeking protection from the great ugly, black beast, that he doubtless thought Sallie to be.

I have seen the orang-utans in the New York Zoological Park sitting at table, drinking out of cups and eating from plates, using spoons, knives, and forks, but not with the same readiness and ease with which the chimpanzee learns to do these things. There is, however, one accomplishment of the orang-utan I wish to emphasize, for in this he is an adept. It is using a blanket to cover himself. I have never seen an ape so young that he was not able to take a blanket and pull it over himself, without any previous teaching. This accomplishment seems to be an inherited habit or instinct. In their native country these apes probably cover themselves with large leaves.

At one time, when with the Edwards' Animal Show, we had a big orang-utan who was unusually intelligent. He learned all the coins from the silver dollar down to the copper cent and rarely made a mistake in picking out the coin asked for. On a certain evening he was given some English walnuts, and ate all but one, which dropped outside the cage and rolled just beyond his reach. His



appetite was satisfied and he made no special effort to get this nut. The next morning, however, he was hungry, and tried to reach it with his long arms. But it was a little too far away. After some minutes of silent thoughtfulness, he tried to roll some of the straw on the bottom of his cage into a sort of wand, by means of which he might reach the nut. But the straw was too much broken. Then there was another period of silent thoughtfulness. At length he began taking off his sweater. We wondered why he was doing this, as he was not in the habit of undressing himself unless we gave him permission to do so. Slowly and deliberately he unbuttoned the garment and drew his arms out of the sleeves. Then, pushing the sweater out through the bars of the cage, he swung it forward till it dropped over the nut, and gently drew it towards him, repeating this procedure until the nut was within reach. Thereupon he took the coveted morsel, cracked it, ate the kernel, then as carefully and deliberately put the sweater on again.

Of all the anthropoids, I have found the chimpanzee the most lovable. You cannot but feel he returns your affection as truly and sincerely as a human child. I have seen a young chimpanzee, on being taken from the shipping box in which he came to America, throw his arms about the neck of a man he had never seen before and hug him affectionately. I once had a little fellow who would snuggle up to me, then take my arm and put it about him. I had another, a big specimen, who frequently wanted to kiss me, and always on the lips. This, in spite of his good intentions, was not always a pleasant experience, for usually his lips were not very clean. I have known chimpanzees so attached to their keeper that they

would fight for him, attacking another man or even one of their own species.

My introduction to Mr. Joseph Edwards of the Edwards' Animal Show, was unique and characteristic. I had come to the menagerie in the absence of the proprietor. One evening, two or three weeks after I had entered on my engagement, I was lecturing on the four-year-old chimpanzee, who was sitting on a little chair on the stage. Just as I was finishing my talk, she gave utterance to a half dozen ecstatic, bark-like notes, and rushing across the stage past me, threw her arms in an exuberance of delight about the neck of one who was a stranger to me. I needed no further introduction. She had not seen Mr. Edwards for four or five weeks, and others had been feeding her, yet her greeting was one of the deepest affection.

To me one of the most remarkable things about the chimpanzee is the fact that he understands how to express affection and gratitude by hugging and kissing without being taught. This can only mean that these modes of expression are very, very old in the primate group. Indeed, they may not be confined to the primates. The elephant, though far removed genetically, has a similar mode of expression. I once had a large female of the Indian species who was very fond of me. Not infrequently when I was passing near her, she would reach over, take me by the arm, pull me up close to her side, and put my hand in her mouth, giving my fingers a gentle squeeze with her lips. It was her way of showing affection. The dog's habit of licking the face or hand of his master is well known. Kissing may be as old as the tactile sense.

The kiss of the chimpanzee is not a smack of the lips, but a lingering, caress-

ing touch of the lips to the bare neck of the keeper, to his hand, or to his shoulder, and frequently accompanied by a gentle pressure from the teeth. The way these apes commonly greet each other in captivity, and I presume in a state of freedom as well, is by an embrace—by throwing the arms about the neck or shoulders and giving a gentle squeeze. I have seen a large female chimpanzee, which had been some time in captivity, rush up to a smaller specimen newly arrived with cries of delight, and give the newcomer a gentle hug. I have seen this same big chimpanzee greet a baby orangutan in the same way.

This ape has the most fully developed sense of gratitude of any animal I know. He just must thank somebody for every esteemed favor. If he cannot get to the one who does him the favor, he will hug someone else. One afternoon, Sally, the big female chimpanzee mentioned above, saw the keeper approaching with a large bunch of grapes, a fruit of which she was inordinately fond. She began screaming with delight. He came only to the guard rail and handed the grapes across. She could not reach him from the stage, so she turned and threw her arms about me. One night, when she was very tired, she noticed the Senior Mr. Edwards getting out her sleeping box. She gave forth two or three long-drawn-out notes, followed by sharp, quick, truncated barks of delight, rushed to her master and hugged him frantically, turned to me and hugged me till she almost choked me, then hurried over to a negro at the end of the stage and hugged him too.

On the other hand, the chimpanzee will sometimes become angry and attack. The habit of these apes to cling together and fight for each other

makes it necessary for the keeper always to be on his guard. His intentions toward one ape may be misinterpreted by another and he will have both of them on his hands. One morning in Chicago I was giving an exhibition with Joe, a young chimpanzee of remarkable intelligence and usually very good-natured. But on the occasion in question he had a cold and was not in the best of humor. He refused to do what I asked and began screaming. Mike, a big burly brute, gave his well-known war cry and came for me like an enraged tiger. Fortunately the little fellow was between Mike and me, and a chair served as an additional obstacle. As a result I had time to seize a small stick which I had been using as a pointer and to give Mike two sharp cuts across the face, which turned him; but it was only by the greatest dexterity that I saved myself from the great jaws of the savage beast.

In general the chimpanzee is, however, very good-natured and obedient, ready and anxious to do what is asked so far as he comprehends. In Peoria, Illinois, I had a little chimpanzee named Adam, who made his public appearance in a gocart. As I was answering some question, my attention was withdrawn from him for a few minutes. The little fellow seized the opportunity to climb out of the cart and, when I noticed him, was stealthily making off. I said in a quiet but firm tone, "Adam, get right back in here." Without the slightest hesitation, he returned and climbed into the gocart. A bystander exclaimed, "Well, he obeys better than my kids!"

Adam was one of the best-natured, most peace-loving animals I have ever known. One evening I was alone in the menagerie. Everybody else had gone



FOUR OF MR. SHEAK'S CHIMPANZEE FRIENDS

Content, though crowded, these four apes present the pleasant side of chimpanzee clannishness. These animals are not merely passively friendly, however; on occasion they will fight for one another. Mr. Sheak had a narrow escape one time from the fierce attack of Mike, the big ape on the extreme right, who rushed at him in response to a scream that Joe, the ape next in order, gave forth. The two apes huddled at the lower end of the cart are not mentioned in the text. One of them, the ape next to Joe, was with Mr. Edwards for nearly ten years, and on the road most of that time. She probably holds the world's record for longevity of the chimpanzee in a traveling menagerie

out to dinner. I was sitting near the chimpanzee cage writing a letter, when a large savage female began screaming in angry tones. A few minutes earlier the apes had been fed potatoes boiled with the skins on. She had swallowed hers greedily and was now reaching for

spoon through the bars. One day when she was thus engaged in feeding a pair of gray spider monkeys, Mr. Edwards appeared with a bunch of grapes. Immediately she began stamping her feet, screaming, and making a frightful noise, which drove all the other simians



Joe is posing for his picture, his eye fixed upon the young photographer, while Darwin looks down from the frame on the wall

little Adam's share. She was afraid to take it from him by force while I was so near; but to my utter astonishment the little fellow broke his potato in two and gave her half of it.

Most chimpanzees are, however, not so willing to divide. Sometimes Sally, when she had eaten all the rice she cared for, would feed what was left in her dish to the little monkeys in a cage near her, dipping the contents out, a spoonful at a time, and handing the

to the farther end of the cage. On receiving the grapes she again turned toward them and gave two or three savage barks. She was perfectly willing to divide the rice, which she did not want herself, but not the grapes, which she did want. When Joe was given two apples and told to present one of them to his little sister, he would, if one was larger than the other, invariably hand her the smaller one, keeping the larger for himself, but if they were about the

same size, he would take a good bite or two out of one of them, then hand that one to her.

No animal below man possesses a higher degree of intelligence than the chimpanzee, if, indeed, any equals him. The orang-utan approaches him very closely in intelligence. The psychology of the gorilla is almost unknown to us, but we judge from the relative size of the brain and its convolutions that he ranks very high intellectually. We have no reason to believe, however, that he surpasses his smaller cousin.

Joe was one of the most wonderful animals I have ever known. We made no special effort to teach him anything, but he was a close observer and a persistent imitator, and picked up many clever tricks. He learned to wipe his nose with a handkerchief, brush his hair with a hairbrush, clean his clothes with a whisk broom, drink out of a cup, eat with a spoon as well as any human child, bore holes with a brace and bit, use a handsaw quite dexterously, take screws out of the guard rail with a screw driver, drive nails with a hammer and pull them out with the claw of the hammer, and to play on a toy piano and on a mouth harp.

Joe was full of mischief and dearly loved to tease a little Mexican dog that usually slept near his cage. He would reach out and give the dog a pinch,

then quickly jerk his hand back before the canine could nip him. In this way he kept the dog in a constant state of irritation and always ready for a fight. One day Mr. Joseph Edwards came into the room with some oranges and laid one under the dog's nose, wondering how Joe would solve such a problem. But it was no problem at all for Joe. He got the hammer, poked the handle through the bars till he got the dog to biting at it, then gradually worked the dog away until he could safely reach the orange with his other hand.

In Kansas City we kept the chimpanzees in a very large cage, almost the size of an ordinary bedroom. We had some ropes attached to the roof of the cage by bolts with a ring in the lower end. One of these bolts came out and fell to the floor. Mr. Joseph Edwards got in the cage, picked up the bolt, handed it to Joe and said, "Now you get up there," pointing with his finger, "and put this bolt through the hole, and hold it there till I fasten it." The little ape climbed to the top of the cage, holding on by one of the other ropes, inserted the bolt in the hole, and held it till Mr. Edwards climbed on top and made it fast. The head keeper, who was standing near me, expressed the thought and feeling of all of us when he exclaimed, "By George, that's going some!"



# "The Minds and Manners of Wild Animals"

AN APPRECIATION OF DR. WILLIAM T. HORNADAY'S LATEST BOOK<sup>1</sup>

By WILLIAM BEEBE

Director of the Tropical Research Station of the New York Zoological Society at Kartabo, British Guiana

SINCE the time of Noah interest in animals has never flagged, and from a certain afternoon in the Garden of Eden up to the most recent pronouncements of W. J. Bryan animal psychology has been an important factor in the life of mankind. Dr. William T. Hornaday has marshalled all the more important observations he has made during a long and intensively observant life, on the minds and the manners of animals, and has used them as morals, as texts, as examples, either delicately to suggest some hypothesis, or with sledge-hammer blows to force home some vital truth in the relations of animals and mankind on the earth today.

To those of us who have been associated with Doctor Hornaday for the two decades of his splendid administration of the New York Zoological Park, many of these pages will appear as memoirs of the doings of certain furry quadrupeds and feathered bipeds; there are chapters which, in faithful delineation of character, could be entitled "The Mirrors of the Zoological Park." To the general reader the book will appeal with all the charm of absorbing animal stories and anecdotes, which at the same time are logically bound together, dignified and clarified by the context of direct application.

Doctor Hornaday has the courage of his convictions and has covered the entire range of psychology of the higher vertebrates, with mammals as the dominant interest.

On the first page we learn his

attitude toward evolution: "To the inquirer who enters the field of animal thought with an open mind, and free from the trammels of egotism and fear regarding man's place in nature, this study will prove an endless succession of surprises and delights." Three pages later his estimate of mechanism is revealed: "Brain-owning wild animals are not mere machines of flesh and blood, set agoing by the accident of birth, and running for life on the narrow-gauge railway of Heredity."

In the first part of the volume temperament, individuality, language, and the rights of wild animals are discussed. The second chapter, on temperament, is one of the best and most suggestive in the book, and in my estimation furnishes one keynote to animal psychology. Six general types of temperament are recognized: morose, lymphatic, sanguine, nervous, hysterical, and combative. The gorilla is "either morose or lymphatic," the orang-utan "sanguine, optimistic, and cheerful," and the chimpanzee is "either nervous or hysterical." This specific individuality or temperament is evident from mammals to ants, and is the necessary concomitant of the inability of any animal to think "I am I."

Out of the abundance of his experience, Doctor Hornaday gives for the first time lists of bears, deer, and the pachyderms, based on this important phenomenon. Here is a new angle on behemoth: "*Every Hippopotamus*, either Nile or pygmy, is an animal of serene mind and steady habits. Their

<sup>1</sup>Published, 1922, by Charles Scribner's Sons

appetites work with clock-like regularity, and require no winding. I cannot recall that any one of our five hippos was ever sick for a day, or missed a meal. When the idiosyncracies of Gunda, our bad elephant, were at their worst, the contemplation of Peter the Great ponderously and serenely chewing his hay was a rest to tired nerves. . . . It may be set down as an absolute rule that hippos are lymphatic, easy-going, contented. . . ."

And now may I register my strongest objection to Doctor Hornaday's volume, a mere matter of words but none the less important? On page 151 he credits a wild *Ovis nelsoni* with "a reputation for quick thinking, original reasoning and sound conclusions." Now, if I were writing a biography of Doctor Hornaday himself, and taking into consideration all the intricate planning, the able achievement, and the complex intellectual correlation by which he has brought into being and sustained our great Zoological Park, these are exactly the words I should use. And I object to the same unqualified phrases being applied to a wild sheep because it lies down in token of surrender when trapped, and does not try to fight its captor. If these terms are applied to the sheep, I demand some superlatives appropriate to the man, and for them I search my dictionary in vain. I hasten to add for the benefit of Mr. Bryan and the Kentucky legislature that my arguments imply no mental hiatus, any more than physical; I have seen a drop of water and I know the ocean is made up of a multitude of similar particles, but I prefer the word *ocean* to *drops*. The paucity of the English language is such that we cannot afford to stretch to the breaking point such splendid words as reason and intel-

lectual unless we qualify the extremes.

We cannot but admire Doctor Hornaday for his high, generous estimate of the animal mind, and his chapters on the elephant, the chimpanzee Peter, and Major Penny's gorilla offer many surprises. To me the chapter on language is the most interesting, and as there is no attempt to endow animals with talk or speech, every statement is conservative, reasonable, and accurate. This chapter should be enlarged to a full volume along the lines laid down by Doctor Hornaday. With few exceptions other writers have given way to the temptation to Anglicize the calls and songs of wild creatures, with very sad results. The various cries and emotional vocalizations of apes and monkeys make intensely interesting reading. The paragraph on page 30 beginning "Of all the monkeys that I have ever known, either wild or in captivity, the red howlers of the Orinoco, in Venezuela, have the most remarkable voices, and make the most remarkable use of them," is of particular interest at this very moment, for as I write these words in the interior of British Guiana, a chorus of these monkeys comes full strength across the water, and, as Doctor Hornaday continues, "The great volume of uncanny sound thus produced goes rolling through the still forest far and wide."

The second part of the book contains twelve chapters dealing with such subjects as "The Brightest Minds Among Animals," "Keen Birds and Dull Men," and special treatments of the higher apes, elephants, bears, ruminants, rodents, birds, serpents, and the "Training of Wild Animals." For cunning in self-preservation, Doctor Hornaday awards the palm to the common brown rat; for strategy to the

musk ox, while he considers the silver-tip grizzly bear as being the "brightest North American animal," and sets forth excellent reasons for his choice.

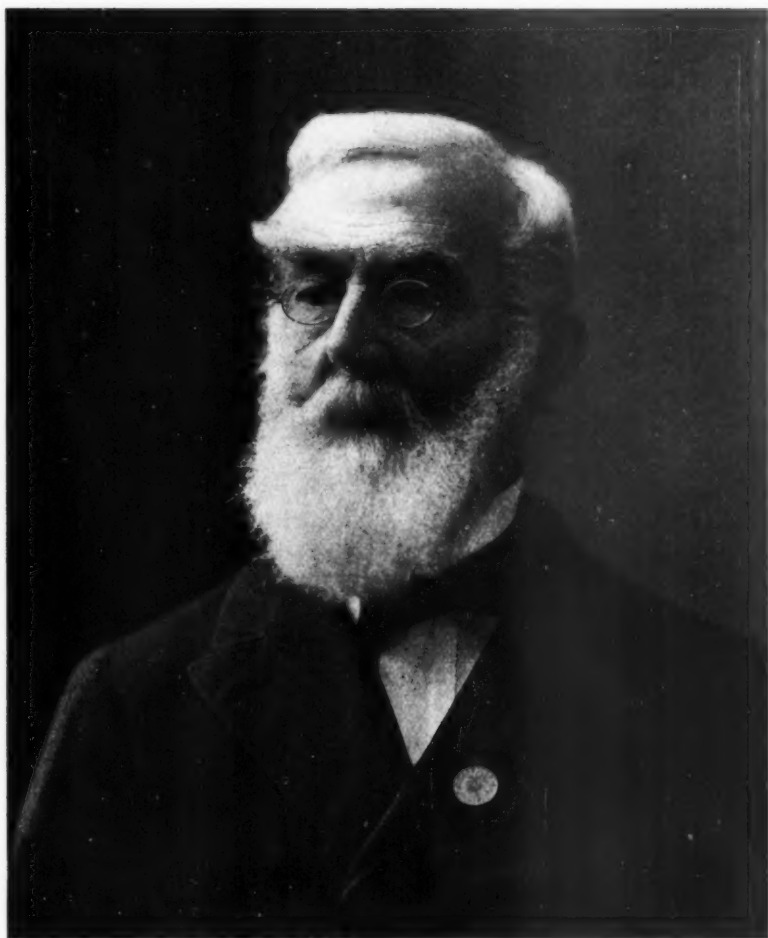
The Higher Passions form the subject of the third section,—morals, laws of the herd, plays and pastimes, and courage. Finally the Baser Passions such as fear, crime, and fighting, are considered.

I am glad that Doctor Hornaday gives rather a low place to avian mentality. Many years ago, influenced by some well-written, plausible volumes, I expected great things of birds, but in the interim I have had to modify my ideas, until I am compelled to place birds hardly above reptiles and fish.

Under the three successive chapters devoted to Play, Courage, and Fear, a splendid array of anecdotes and of striking examples is marshalled. The illustrations have been chosen with judgment and care, and ably sustain their share in the presentation of the subject.

Throughout the work there runs a continuous undercurrent of a plea for better and more intelligent relations between man and the animals which still survive on the earth. Many people will read this volume with interest only in the more exciting anecdotes; they will skip here and there, and throw it aside, turning thence to the sensational parts of a newspaper and neglecting the editorials. To other more worthy readers, for whom the volume is really intended, there will stand out three forceful theses, the successful presentation of any one of which would make the book worth while: first, a body blow to the passing phase of anti-evolution talk; second, an appeal for moderation in the sportsman, and excess in the conservationist; and third, a plea for a sane, intelligent interest in the lives and activities of animals, as a healthful distraction from the egotistical and anthropomorphically narrow confines of thought of the majority of human beings.





*James Hall*

## “James Hall of Albany”—A Review

By GEORGE F. KUNZ

Research Associate, Gems, American Museum

**D**R. JAMES HALL, who was born at Hingham, Massachusetts, September 12, 1811, and who died at Echo Hill, near Bethlehem, New Hampshire, on August 6, 1898, at the advanced age of very nearly eighty-seven, was for a period of more than sixty years preceding his death the most industrious and constructive of our American geologists. An account of his life and work has now

been ably written by his former first assistant, Dr. John M. Clarke, who from 1898 until the present time has been Doctor Hall's able successor as palæontologist of the New York State Geological Survey, and since 1904 has been director of the State Museum at Albany. Doctor Clarke's book,<sup>1</sup> a

<sup>1</sup>*James Hall of Albany, Geologist and Palæontologist, 1811-1898*, by John M. Clarke; 565 pages, 11 plates, and frontispiece portrait. Published 1921, by S. C. Bishop, 2 High Street, Albany, N. Y.

review of which by the present writer appeared also in the *New York Times* (Sunday, September 3, 1922), is of the greatest interest to the entire geological world, but especially to all the members and friends of the American Museum of Natural History, for this institution shelters Hall's great collection of fossils, purchased by the Museum in 1875. The collection embraces 80,000 specimens, which constitute the broadest basis for the study of Palaeozoic geology, and which were the foundation of the magnificent volumes of the *Geology of New York* produced by Hall.<sup>1</sup> More than one third of all known specimens were figured therein, either as specimens new to science or as new and interesting occurrences. Careful drawings of them were made and reproduced in a vast number of the finest lithographic and copper plates of their time. Indeed, any geologist wishing to study Palaeozoic geology, whether American or foreign, will find it impossible to do so without the volumes of the *State Survey of New York*<sup>2</sup> or, to be more accurate, unless he studies the wonderful examples of the earliest known fossil remains of either plants or animals, now in the American Museum of Natural History and in the collection of the New York State Museum at Albany, New York.

When this great collection had been acquired, Dr. Albert S. Bickmore, who was the originator of the idea of a great natural history museum for the city of New York, head of the original administrative staff of the American Museum

of Natural History, and also a member of the scientific staff, invited the present writer, jointly with Dr. C. Frederic Holder, who was the assistant to Doctor Bickmore, to aid in the packing and transportation of the Hall collection. The final shipment by train consisted of an entire carload; for the second shipment by water, an entire hay barge was required.

This collection of 80,000 specimens contained no less than 6400 types. In the New York State Museum, Doctor Clarke tells us, there are at present 10,000 type specimens, Hall's types totaling 4833, while those of later date number 5239. Dr. Philip S. Smith, acting director of the United States Geological Survey, writes: "From a careful estimate of the Palaeozoic type fossils that have accumulated in the U. S. National Museum as a result of the activities of the U. S. Geological Survey, it appears that there are about 18,000 specimens including plants, invertebrates, and vertebrates that may be considered types for the reason that they have served as the basis of specific descriptions and for the most part have been figured. Possibly as many as 6000 species are represented, but it is not practicable, without expending more labor than the importance of the question would seem to justify, to determine how many of these were described as new. It is the custom to treat all figured specimens as types whether they belong to new species or old ones."

Hardy, industrious, zealous—at times over-zealous—and in spite of many serious disputes and differences, Hall rendered great and indispensable service. In a way his activity paralleled that rendered by the great Barrande to the geology of Bohemia. Whatever may be said about the dic-

<sup>1</sup>Doctor Hall's smaller papers, in octavo form, were scattered through the New York State Museum reports, the reports of the State surveys, various scientific periodicals, etc., but as a rule they were very brief and the number of printed pages did not exceed 2500. Thus his total output of geological material may be set down as between 10,000 and 12,000 pages.

<sup>2</sup>Lindström of Sweden wrote Doctor Hall in 1898 "Your Palaeontology of New York will be consulted for ages to come by many generations of Palaeontologists, American and European," and Prof. James D. Dana stated "Without your labors the geology of the North American Continent could not have been written."



tatorial methods used by Hall in his work, we should allow him the same latitude in this respect that we accord the great captains of industry who have built up their wonderful enterprises with just as little regard to the opposition they have encountered. We must judge Hall not by any standard of conciliatory scholarship, but by the thoroughness and importance of the work he accomplished so successfully on the New York Geological Survey.

The salient feature of Doctor Hall's life work was his unswerving devotion to the great task he had set himself, that of making known to the scientific world, in the broadest and most comprehensive way, the unique significance of the territory of New York State in the history of the geology of the world. This great life work has been most convincingly presented by Doctor Clarke, and he has made of his book a truly representative volume. He himself says: "I have tried to set down the story of an unusual man. I hope that it may find a place among the monuments he raised to his science."

Senators Daniel P. Wood and Chauncey M. Depew, Theodore Roosevelt, and the late James W. Husted were Doctor Hall's valiant friends in assuring funds for this greatest of state surveys, thus overcoming very strong opposition. The opportunity of making known the preëminence of New York State from a geologic standpoint was assured through the foresight of its legislators in sustaining financially the production of the great descriptive series of volumes by Doctor Hall and Doctor Clarke, in which its marvelous Palæozoic remains were so splendidly figured.

A tablet has been erected to Doctor Hall's memory in Letchworth Park, overlooking the Genesee. This tablet to our great American geologist parallels in significance that which was erected near Prague to the memory of Barrande.

It is interesting to know that the scene of much of Hall's geological survey has been rendered accessible to citizens of New York State and of the country through the generosity of Mrs. John Boyd Thatcher, manifested in the gift to New York State of the John Boyd Thatcher Park. Here, in a stretch of three miles along the rim of the famous Heilderbergs, we have before us, in a wonderfully impressive way, the series of strata from which Hall secured the splendid fossils which he described in such masterly style. With the rapid growth of our enterprising nation, study is being devoted more and more ardently to its historic beginnings, and it is only natural that in the course of this study our thoughts should be carried back to the formation of the continent on which this great development of civilization has been brought about.

Doctor Clarke presents the mass of facts he has assembled in so clear and graceful a literary style that the story of Hall's life and of the wonderful period of the world's history to which he devoted his studies reads like the romance of a great author. The volume is one of unusual interest to the general reader, and ought to have a place in every collection of Americana, for it has bearing not only on the fundamental formations of New York State but also on those of the entire continent—we might, indeed, say of the entire world.



A whale shark, caught on the bow of a 17,000-ton steamer. This picture is from a photograph supplied by Captain Charles H. Zearfoss, the master of the vessel, and retouched by Mr. William E. Belanske under the supervision of Dr. E. W. Gudger

## An Extraordinary Capture of the Giant Shark, *Rhineodon Typus*

BY E. W. GUDGER

Associate in Ichthyology, American Museum

ON JUNE 2 there called at the department of ichthyology, American Museum, Mr. C. F. Krauss of San Francisco, who related the story of the capture of a shark such as had never been told before. The incident had occurred during a voyage of the Munson liner "American

Legion," along the eastern coast of South America, and Mr. Krauss had come to the Museum in the belief that his report of the event would be of interest and also to seek information as to the identity of the shark.

Mr. Krauss told the members of the department that on the early morning

of May 19, 1922, while somewhere north of Rio, the ship had struck a giant shark about one-third of the distance back from the snout toward the tail. So perfectly balanced was the fish, that it had hung on the bow for several hours and was finally detached only with some difficulty. He said that the fish was about thirty feet long and covered with yellow spots about the size of a silver dollar, and that the ship's people called it "leopard shark" and "tiger shark" on account of these spots.

From the description of Mr. Krauss I was satisfied that the fish was a *Rhineodon*, well-named "whale shark" because of its great length and bulk. However, he suggested that I write the master of the vessel, Captain Charles H. Zearfoss, for data. This I did and presently I received from him two photographs (copies of which were also brought later by Mr. Krauss) and a letter which left no possibility of doubt that the shark was, as surmised, a *Rhineodon*.

Captain Zearfoss's very definite and clear-cut statement of this extra-

ordinary happening is as follows:

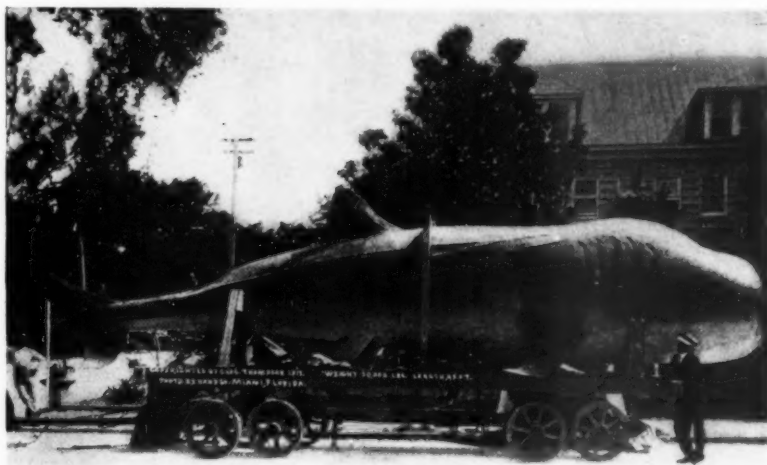
Some time during the morning of May 19, while this vessel [the steamship "American Legion"] was crossing over the banks which lie northeast of the Abrolhos Light in Lat.  $17^{\circ} 57' S.$ , and Long.  $38^{\circ} 41' W.$ , a shark in attempting to cross our bow was struck by our stem. The speed of the ship through the water then held it doubled round our bow.

There was no shock (except to the nerves of the fish) and its presence was not discovered until daylight.

During the morning an attempt was made to lift the body out of the water, but without success, and later the ship was stopped and backed, when the shark was washed clear and immediately sank.

The shark was struck immediately behind the last gill and hung with eight feet of head and gills on our port side and about twenty-two feet of body on our starboard side.

To Mr. Krauss and Captain Zearfoss I am indebted for the data which enables me to set before the readers of NATURAL HISTORY the most extraordinary instance known to me of shark fishing. Surely no one before ever used, for the purpose of spearing a fish, a 17,000-ton steamer.



A whale shark captured in 1912 by Captain Charles Thompson and mounted by Mr. J. S. Warmbath. The huge proportions of this fish dwarf by comparison the man who is leaning against the truck. After Townsend, 1913.



A POLYNESIAN FISHERMAN

# The Racial Diversity of the Polynesian Peoples

By LOUIS R. SULLIVAN

Assistant Curator, Physical Anthropology, American Museum

THE racial origin and relationships of the Polynesians have been the subject of much speculation and discussion. Earlier students of anthropology not only emphasized their uniformity in culture and language, but also used them as a standard example of a remarkable uniformity of physical type extending over a greatly diversified habitat. They are described as being almost identical in physical appearance from Hawaii to New Zealand and from Samoa to Easter Island.

The more intensive work of recent years has led, however, to a modification of the statements maintaining a uniformity of culture and language. Several major and countless minor migrations have been hypothesized to account for differences or similarities in these respects. In the main, these migrations have been attributed to different groups of the same race. There is, however, a growing tendency to regard the Polynesians as a mixed people. But here again a majority of the students seem to feel that the fusion has taken place outside of Polynesia and before migration into that region. There has also been a great diversity of opinion as to what are the component elements. Melanesian, Negrito, Indonesian, Proto-Armenoid, Alpine, Malay, and Australoid mixtures have been suggested as the possible causes of diversity of physical types in Polynesia. But, in the main, these explanations must be regarded merely as suggestions. To hold an opinion, even if it be a correct one, does not advance

science. It is only when the basis for that opinion is analyzed and demonstrated to one's colleagues that that opinion becomes a contribution to science.

Of those who believe that the Polynesians are a mixed people there are few who have taken the trouble to publish the evidence which converted them to that view. The most noteworthy of the contributions that have come from those who have made a detailed study and analysis of the available data is that of Professor Dixon of Harvard University. On the basis of the published craniometric data he proposes four types, which he names in terms of their characteristic brain case and nasal opening forms: a brachycephalic, hypsicephalic, and platyrrhine type; a dolichocephalic, hypsicephalic, and platyrrhine type; a dolichocephalic, hypsicephalic, and leptorrhine type; and a brachycephalic, hypsicephalic, and leptorrhine type. All of these types have high brain cases (are hypsicephalic). Two are long-headed and two are short-headed. One each of the long-headed and short-headed types is narrow-nosed; the other is wide-nosed. These types are tentatively identified as Negrito, Melanesian, Caucasian, and Malay.

Now while there was and is some doubt whether these types as named are all to be found in Polynesia in sufficiently large numbers to be regarded as factors in the history or prehistory of that area, there is no doubt of the physical diversity that



their proposal implies. Professor Dixon does not claim that these elements or types entered Polynesia as pure types or by separate migrations. He does not say which type is the true Polynesian and makes no effort to identify any of his types with specific migrations. He made it clear that many more data were needed to throw light on these phases of the problem.

At the time of Professor Dixon's publication very few detailed studies on the living Polynesians were in existence. Through the generosity of Mr. Bayard Dominick the Bernice Pauahi Bishop Museum of Honolulu has been enabled through expeditions to help remedy this deficiency. These Dominick Expeditions have supplied data from Samoa, Tonga, the Marquesas, Rapa, and Hawaii. In Samoa and Tonga the studies were made by E. W. Gifford and W. C. McKern; in the Marquesas, by E. S. Handy and Ralph Linton; and in Rapa, by J. F. G. Stokes and R. F. Aitken. The American Museum of Natural History was invited to assist in the planning and carrying out of these expeditions. The department of anthropology of this Museum has been responsible for the somatological part of the surveys and donated my services to make a study of the Hawaiian people and to analyze all of the anthropometric data contributed by the anthropologists above mentioned. The physical anthropology of this project has been throughout a cooperative study. Each of the men named has generously turned over to me his field notes on this phase of the subject in the hope that uniformity in analysis and interpretation might result in a contribution of greater value to Polynesian anthropology than would a series of independent and uncorrelated efforts.

The records from Samoa, Tonga, Marquesas, and in part those from Hawaii have been analyzed. So far I have succeeded in isolating two physical types, each of which is still represented by large numbers of individuals. I have tentatively called these types Polynesian and Indonesian. Their characteristics are indicated in the accompanying table.

The unsuspected presence in large numbers of this Indonesian type in Polynesia explains the often expressed opinion that the Polynesians and Indonesians are closely related types. An unfortunate confusion in terminology has done much to keep this opinion alive. One group of anthropologists has called a type in Indonesia which resembles the Polynesians, Indonesian. The other group has called a type in Polynesia which resembles the Indonesians, Polynesian. On any other basis than this there can be no reason for assuming a close relationship between the two types. From the characteristics listed in the table, it will be seen that the Indonesian is the antithesis of the Polynesian in nearly every detail.

The Polynesian is usually described by students of Polynesia as Caucasian in origin. It must be admitted that when the Indonesian traits are removed, the Polynesian is strikingly Caucasoid in appearance. If this is merely a parallelism in development, as some imply, it is most certainly a remarkable parallelism. At this time it is impossible to determine the exact place of the Polynesian in the human family. The available data seem to indicate that the Polynesian is a type intermediate between the Caucasian and the Mongol. At present I am inclined to believe that it is an offshoot from the primitive Mongoloid stem

## POLYNESIANS

1. Light brown skin
2. Wavy hair of medium texture
3. Medium beard development
4. Medium body hair development
5. Moderate frequency of incisor rim
6. Lips of average thickness
7. Moderately long heads  
Average cephalic index 77-8
8. Tall, average stature 171 cms.
9. Very high and moderately wide faces  
Average facial index about 90
10. Very high but very broad noses  
Average nasal index about 75
11. Nostrils oblique
12. Nasal bridge elevated more than average
13. Chin fairly well developed
14. Eye fold absent
15. Often lean and lank when unmixed
16. Platymeric (shaft of femur flat)
17. Platychemic (shaft of tibia flat)
18. Platolenic (shaft of ulna flat)

## INDONESIANS

1. Medium to dark brown skin
2. Wavy hair
3. Scant beard development
4. Scant body hair development
5. Incisor rim absent
6. Lips above average in thickness
7. Short heads  
Average cephalic index about 81-2
8. Shorter stature, average uncertain
9. Very low, broad faces  
Average facial index about 80
10. Very low and very broad noses  
Average nasal index about 87-8
11. Nostrils transverse
12. Nasal bridge low
13. Chin somewhat below average
14. Incipient eye fold
15. Heavy with short necks
16. { Skeletal characters uncertain.
17. { but not so flat as
18. { Polynesians

close to where the Caucasian stock arose. Egotistically we may regard the Polynesian as a somewhat unsuccessful attempt of nature to produce a Caucasian type. That the Polynesians are closely related to the Caucasoid stock there can be no doubt. Some such type as this must have given rise to the Caucasian. Descendants of this or a closely related stock pass for Caucasians in Europe today. The final classification of the Polynesians is somewhat dependent upon the systematic position of certain American Indian groups, the Aino, and certain other Caucasoid or pseudo-Caucasian types in Malaysia and Asia. Their relationship to the Aino is pretty clearly indicated.

The affinities of the Indonesian element in Polynesia are also somewhat uncertain. The Indonesian is usually looked upon as Mongoloid but in this study its Negroid characters are

emphasized. Although the hair of this Indonesian element is only moderately waved, other characters, such as the very low broad nose with transverse nostrils, the very low broad face, the thick lips, and the dark glabrous skin are Negroid. Tentatively the Indonesian may be accepted as a somewhat doubtful Mongoloid type diverging strongly in the direction of the Negro or Negrito. It is possible that this type is identical with that described by Professor Dixon as Negrito, though this is by no means certain; but if not, there are two brachycephalic, platyrhine types in Polynesia. This type, whether represented by skeletal remains or by living individuals, has often been mistaken for Melanesian and Negrito not only in Polynesia but also in Indonesia.

The Polynesian type is found throughout Polynesia. The distribution of the Indonesian type is not so



TYPES APPROACHING THE POLYNESIAN NORM  
(Some of these are typical in that they have short heads)



TYPES APPROACHING THE INDONESIAN NORM

well known. It occurs in Samoa, but is pretty well intermingled there with other strains so that it is difficult to determine what proportion of the population it forms. In Tonga it is very important and less mixed. It is more concentrated in Haano of the Haapai group than in the southern islands of this archipelago. In the Marquesas it is a very important element in the population, but is confined for the most part to the northwestern islands of Uauku, Nukahiva, and Upu. In Hawaii it is important but pretty thoroughly interpenetrated with the Polynesian element as well as the modern immigrant population of these islands.

From the frequency and distribution of these two quite distinct physical types in Polynesia, it is clear that they must have entered the Pacific at different times and possibly by independent routes. Certainly they must have had different languages and cultures. The next problem in Polynesian anthropology is to associate these two physical types with their proper linguistic and cultural elements, to determine what each has contributed to the past and present cultures of Polynesia, and to determine which type was the predecessor in Polynesia.

At first glance this seems simple enough, but further study makes it evident that no generalizations can be made at present. In the Marquesas Doctor Handy has found differences in language and culture which correspond roughly to the distribution of the two physical types. It may also turn out that the first type to enter Polynesia was not necessarily the first type throughout the whole of Polynesia. The present distribution of the two types, so far as I can determine it, lends itself to two interpretations. The

Polynesians are to be found in all parts of Polynesia. The Indonesians are not at present to be found in all parts of Polynesia, nor indeed in all parts of the island groups in which they occur. Are the Indonesians late arrivals, not yet spread throughout the whole of Polynesia, or were they the first comers to the islands in which they are now found? Physical anthropology alone cannot answer this question. The corroborative evidence of archæology and ethnology will be needed. The fact that the Indonesian element is so poorly represented in the skeletal remains to which I have had access inclines me to regard the Indonesians as recent arrivals. Yet it is possible that they were the first arrivals in Polynesia or at least in certain parts of Polynesia. The Indonesians rather than the Melanesians may be the short dark predecessors of Polynesian tradition. The order of arrival may vary from group to group. These then are questions for the future.

In addition to these two types there is a Melanesian element in certain parts of Polynesia. Melanesian influence is naturally strongest in the south and west. It is present to some extent in Tonga and has also been described in New Zealand and Easter Island. On the whole, the Melanesian physical element in Polynesia has been exaggerated. The influence of the Polynesians on Melanesia has been greater than that of the Melanesians on Polynesia.

None of these types accounts for the extreme degree of brachycephaly or short-headedness characteristic of certain parts of modern Polynesia, notably Tonga, Samoa, Tahiti and near-by groups, Hawaii, and, to a lesser extent, the Marquesas. The Indonesians are only very moderately brachycephalic. But in the groups named indices of 90



and above are frequent. It is to this element of the Polynesian population that Professor G. Elliot Smith has referred as Proto-Armenoid. It corresponds to Dixon's brachycephalic, hypsicephalic, leptorrhine type. This element has also been described as the true Polynesian by some students. Others have referred to it as Indonesian. It is perhaps the most Caucasoid element in the population. So far I have not been able to associate a sufficiently large number of distinctive characters with this undoubtedly artificially shortened head to warrant its isolation as a separate type. I accounted for it at first by calling it a Polynesian type with an artificially flattened occiput. Its classification as Polynesian is still an open question and further research may prove it to be indeed a distinct type. Strangely enough it is not an important element in the skeletal material. Again, this leads me to believe that either artificial flattening is a new custom or that the type has arrived only recently in Polynesia. Only in Tongan skeletal remains is the type a dominant element.

So far then these studies confirm the impression that the Polynesians are a mixed people. In addition to any Melanesian element that may occur, there is the Polynesian type, which

approaches the Caucasian type, and the Indonesian type, which approaches the Negro or Negrito type. Both may be divergent Mongols. As yet it is uncertain whether the extremely short-headed types are Polynesians with artificially deformed heads or another element in the population of Polynesia. It is certain that the short heads are due to some extent at least to artificial deformation.

In brief, like Professor Dixon, I recognize four elements in the population of Polynesia. Unlike him I do not call them Negrito, Melanesian, Caucasian, and Malay, but Indonesian, Melanesian, Polynesian, and Polynesian(?) with deformed head. The Polynesian and Indonesian types are by far the more numerous and important elements of the population. The sequence of all of these types is yet to be determined. There is still much to be learned about the physical characteristics, racial origins, and affinities of the population of Polynesia.<sup>1</sup>

<sup>1</sup>Detailed reports on the physical anthropology, archaeology, and ethnology of the Polynesians will be found in the current publications of the Bernice P. Bishop Museum, Honolulu, Hawaii. Doctor Dixon's article appeared in the *Proceedings of the American Philosophical Society*, Volume IX, No. 4, 1920, p. 261. Te Rangi Hīrea (Doctor R. H. Buck), himself a Maori, is publishing serially an important somatological study of his race in the *Journal of the Polynesian Society*, Volume XXI, 1922. In addition to the standard and approved anthropometric results, Doctor Buck discusses the linguistic and traditional evidences or explanations of diversity in physical type.



*Photograph by R. M. Overbeck*

AN IMPROVED TRAIL SWITCHBACKING OVER THE DIVIDE OF THE QUIMSA CRUZ

# Bolivia's Least Known Mountain Range<sup>1</sup>

By EDWARD W. BERRY

Professor of Palaeontology, Johns Hopkins University

THERE is mystery and romance for us in a region that has remained practically unchanged for a thousand years, and in far distant peaks rarely visited by white men, which I suspect is an inheritance from that remote past when the successive waves of human emigration diverged from Central Asia during the Old Stone Age. Such a region is the Quimsa Cruz Range, or Nevados de Quimsa Cruz, as it is known locally, in the eastern Andes of Bolivia. From La Paz the serrated peaks of this range form the sky line to the southeast beyond Illimani, of which they are the southward continuation. Often when in that city I looked at their serried ranks—for they are plainly visible in the clear air although about fifty miles away—and wondered what sort of a country their spirits guarded. I had heard of Choquetanga, Suri, Quime, and Inquisivi, and many tales of fabulous tin mines and tropical, mist-covered country beyond, but delayed making the trip because of a "flu" epidemic among the valley Indians with whom it would be necessary to associate.

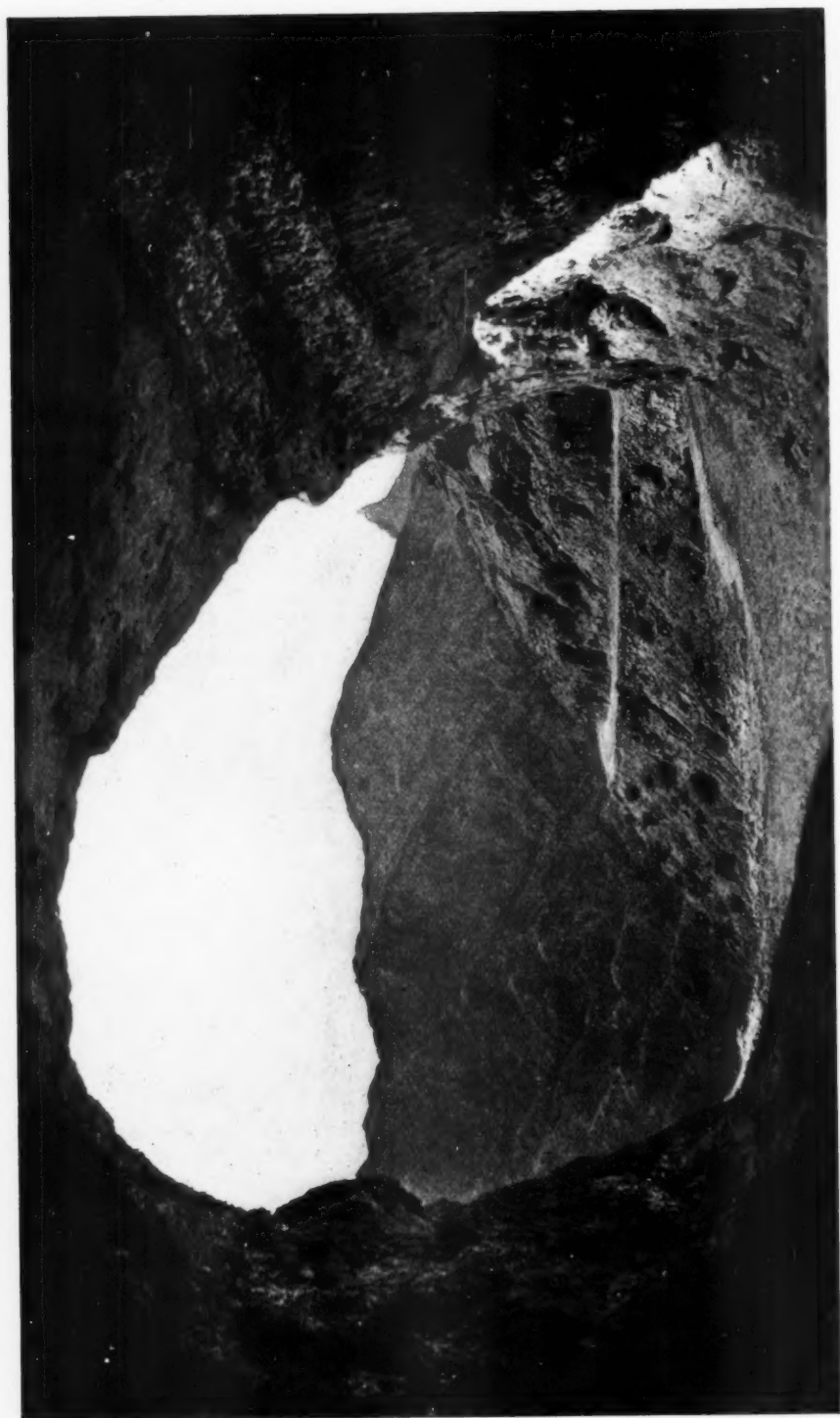
There are many peaks in the Andes that rise to heights of more than 20,000 feet, and although these mountain slack a certain beauty when compared with the Alps or the Rockies because of the total absence of vegetation anywhere except on their eastern flanks facing the Amazon Basin, this deficiency is offset to a certain extent by the wonderful clearness of the atmosphere in that arid climate and by the coloration of

soil and sky that goes with aridity. When it is recalled how seldom a peak like Mount Stephen or Robson Peak in the Canadian Rockies is free from clouds, the way the Andean peaks stand out in all their majestic proportions can be fully appreciated.

The most beautiful stretches of Andean scenery are nearly all remote from the traveled paths. There is, however, one exception to this statement—the Cordillera Real—and no range more fittingly deserves the term royal. It is close to Lake Titicaca and La Paz, on the familiar loop from Molendo up to La Paz and down to the waiting steamer at Arica for Antofagasta. When the tourist agencies that are now advertising South American trips learn to use the day steamers on the lake instead of the night boat, the interest of the trip will be enhanced a thousand-fold, for the two most beautiful mountain masses in the world are Sorata at the northern end and Illimani at the southern end of the Cordillera Real, both more than four miles in height and with wonderful snow fields and glaciers.

A trip by mule-back over the Cordillera Vilcapampa in southern Peru and down to Sandia takes one through magnificent scenery, and the old volcanos and lava fields to be seen in the western Andes of northern Chile are wonderful in a different way and easily accessible. There are many more extinct volcanos with perfectly preserved craters within a few miles of the Antofagasta Railroad than there are

<sup>1</sup>George Huntington Williams Memorial Publication No. 20. The photographs, except where stated otherwise, were taken by the author's colleague, Prof. Joseph T. Singewald, Jr.



A TUNNEL ALONG THE LA PAZ VALLEY TRAIL THROUGH DETRITAL MATERIAL WHICH ONCE FILLED THE VALLEY TO A GREAT DEPTH AND REPRESENTS THE WASTE FROM THE SLOWLY RISING MOUNTAINS



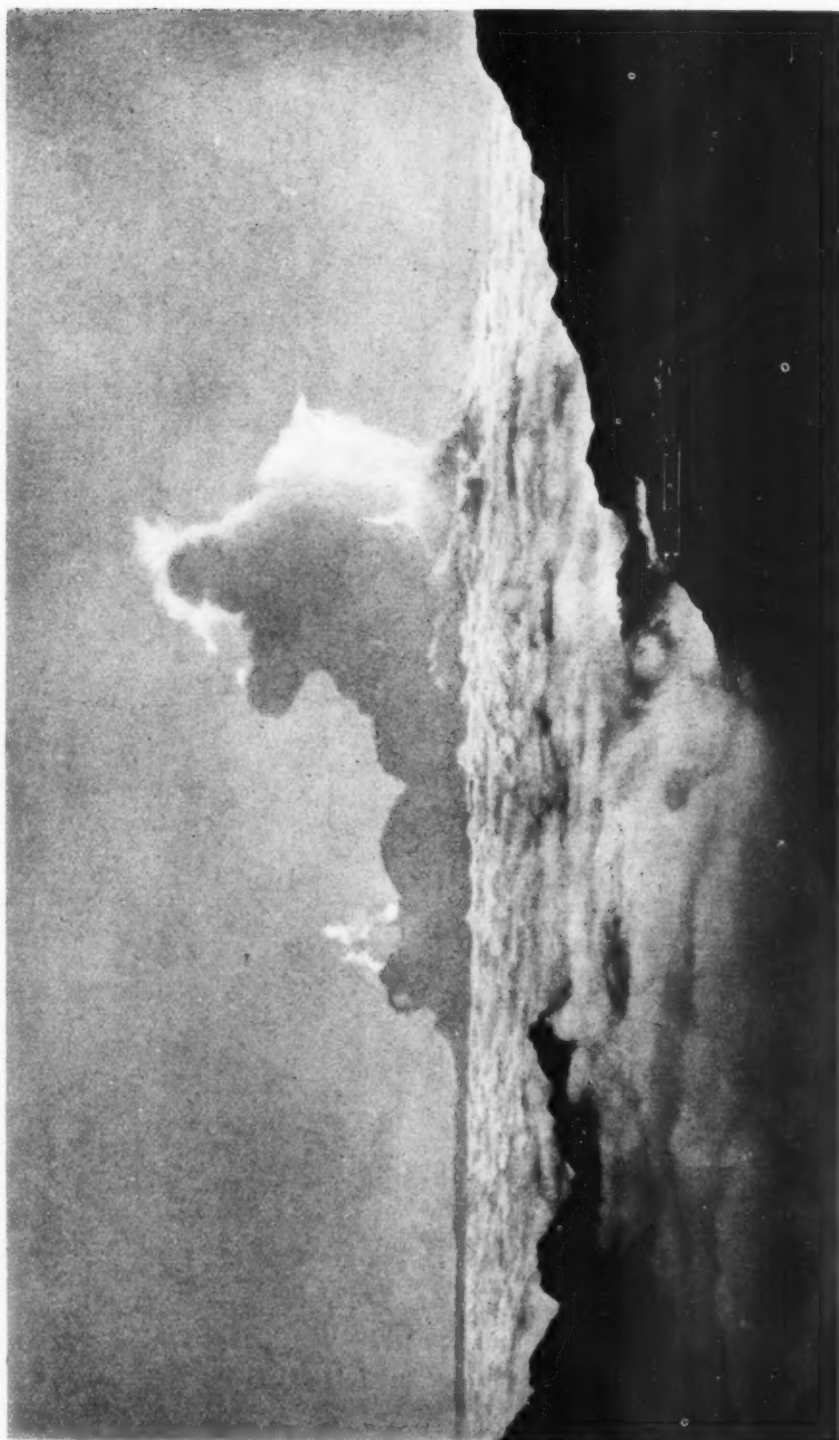
VIEW LOOKING DOWN THE DRY VALLEY OF THE LA PAZ RIVER





SANTA VELA CRUZ

The ages-old trail passing across the Tres Cruces pass to the eastern low country is seen in the lower left-hand corner of the picture



*Photograph by R. M. Overbeck*

THE CHOQUETANGA VALLEY FROM HUANCHACA

Looking eastward from the Quimsa Cruz at the sea of clouds that daily drifts westward from the low Amazon country



LOOKING NORTHWEST AT ILLIMANI FROM HUERTA GRANDE



VIEW LOOKING EASTWARD AT CERRO JACHACUNOCOLLO, OR GREAT SNOW MOUNTAIN, FROM CHOJÑACOTA OR GREEN LAKE

in all of the Auvergne, and they are ten times the size of the latter, and nowhere can one get a more vivid impression of nature's forges gone cold than in this region. None of the mountain groups mentioned, however, has more beauty compressed within a few square miles than has the Quimsa Cruz.

Finally, on a July morning in 1919, a start was made for the Quimsa Cruz. The trail follows the La Paz valley through Indian towns almost entirely hidden in prickly-pear thickets, and past wayside *chicharias*, that furnish refreshment to the great number of pack trains met with, for this is a much traversed highway leading down to the eastern low country, and the commercially inclined ever lie in wait near the centers of population to get the wayfarers' money, whether these wayfarers be Indians or of a more advanced race.

*Chicha*, which gives its name to the *chicharias*, is a varying alcoholic beverage, not to be confused with the light wine of that name which is so popular in Chile. It is made from corn and is often termed *cerveza de maíz*, or corn beer. It is a universal drink in the Peruvian and Bolivian Andes, and the vendors advertise their wares by displaying a small patch of cloth about the size of a handkerchief at the end of a bamboo pole.

The predilections of the aborigines are well illustrated by the apocryphal explanation of the red, yellow, and green of the Bolivian tricolor. It is said that the red represents the *aji* or native pepper—than which no other has a more distressing and vile flavor to the average Anglo-Saxon palate; that the green stands for the coca leaf, which is about the only article of commerce consumed by the Indian population; and that the yellow

symbolizes the *chicha*, or national beverage. The last is not quite so universal a drink among the Spaniards as among the natives although they do consume a large quantity. When the Bolivian Indian really wishes to celebrate, 40 per cent alcohol is favored in the beverage, and as there are at least one or two *fiestas* in every month, vast quantities of alcohol are consumed.

For the first eight leagues out of La Paz the trail clings to the valley sides and is kept in very good condition—a veritable *camino real*, and I have no doubt that an automobile could get over it although I never heard of one attempting to do so. As the trail approaches the gash which the La Paz River has cut between Illimani—the sentinel of the Yungas—and the Nevados de Araca, it descends to the flood plain of the river. This is in a cañon more than 15,000 feet below the crest of the range, and difficult to traverse. The Finca Millecota, where the first night was spent, is most picturesque with its mellow adobe buildings sprawling around and away from the dusty central patio. The warm red tiles of the roofs, the *Eucalyptus* trees—those ubiquitous aliens of South America,—and the inevitable chapel and belfry without which no *finca* or *hacienda* is complete add to the interest of the scene.

No material is more suited to an arid climate or more artistic than adobe until so-called progress crowns it with a corrugated iron roof, as has happened in many of the larger Andean towns. Millecota interested me because it was there that Sir Martin Conway had some unpleasant experiences in his ascent of Illimani, but our entertainment cost us nothing but much talk, and in the Andes the traveler must be prepared for argument with his pro-



spective host before he can expect entertainment of any kind.

To appreciate fully the magic effects of altitude and water the student must go to the Andes. There you may live at an elevation of 15,500 feet in a miner's shack built at the foot of a great glacier and yet obtain oranges and fresh vegetables from some deep valley only a few miles away. These contrasts exist especially on the southern flank of Illimani, where one may stand on a glacier and look down on fields of sugar cane. The La Paz River is only 5,900 feet above the sea level at that point, and the summit of Illimani, slightly less than fifteen miles away, towers to a height of more than 21,000 feet. We left Millecota before daybreak, at which hour the major domo was perhaps too lazy to crawl out and argue about payment for our supper and lodging. It was a most curious sight to see the familiar constellation of Orion standing on its head in the northern sky, a rather fitting emblem of this land of contrasts.

The rocks hereabouts are Palæozoic quartzites and shales, much folded, their strikes parallel with the general northwest-southeast structural lines of the region. Granite does not appear in the La Paz valley, which fact may explain how the river-cutting kept pace with the rising mountain chain in this region of easily eroded Devonian shales between the granitic mass of Illimani on the north and the considerable area of granite that reappears in the crest of the Nevados de Araca and continues along and to the east of the Quimsa Cruz Range as far at least as Jachacunocollo, or Great Snow Mountain.

It is this granite, of late Tertiary age, that is the source of the tin minerals for which the Quimsa Cruz is destined some day to win inter-

national renown, although many of the veins now being worked and, in fact, all of those known on the west side of the range, are in the Devonian shales and sandstones. These are considerably metamorphosed, but nevertheless fossiliferous at many points. Brachiopods are rare, as is usually the case in rocks that were originally muds, but beautiful trilobites are to be found at Araca and elsewhere near the crest.

The Quimsa Cruz is one of the few regions in the Peruvian or Bolivian Andes where mining was not carried on in colonial days. This neglect is not attributable to its relative remoteness and inaccessibility,—witness Huanavelica or Potosi, the latter still more inaccessible and yet for more than a hundred years the largest city in the Western Hemisphere. The real reason is that in the Quimsa Cruz the familiar association of tin with silver is lacking, and tin had no charms for the *Conquistadores*, or the adventurers who followed in their wake.

The Quimsa Cruz is the southward continuation of the Cordillera Real and is only slightly inferior to that range in altitude. The mountains extend for about thirty miles, from the cañon of the La Paz River southward to the pass of Quimsa Cruz, or Tres Cruces, the first designation being Quichua and the second the Spanish name for this celebrated pass, which somewhat arbitrarily separates the range from the Santa Vela Cruz, adjoining it on the south. There are no ice-free passes over this extent, consequently there are no trails on the flanks other than llama trails too difficult for mules, and the eastern side of the range was at the time of my visit in 1919 as remote and inaccessible as almost any part of Bolivia. Since then the Guggenheim interests have constructed, at enor-

mous expense, a road over the Tres Cruces pass.

The oldest mine in the district is Araca or Viloca, not far from the La Paz valley, and it is a scant twenty years old, which is youthful indeed when compared with the three hundred seventy-five years during which Potosi has been worked. At the junction of the Rio Caracota with the La Paz, in a region of pinkish and greenish slate-like shales, our route left the river bottom and zig-zagged upward over a painfully high divide to the southward, only to plunge down into an equally steep-sided valley and then in turn to ascend a still higher ridge before descending into the Araca valley. It might perhaps have been easier to continue down the valley of the La Paz and up that of the Rio Araca, which joins the former a few miles below the Caracota except for the tornado-like wind which blows up the La Paz valley at this point every afternoon.

Where we struck it, the Araca valley is about 10,000 feet in elevation, and consequently contains considerable vegetation. Higher up there is an abundance of cacti, bromeliads, and thorn bushes. One bromeliad in particular—a species of *Puya*—frets the slopes as with a black lace *mantilla*, the prostrate, blackened trunks as big as a man's thigh interlacing in every direction, and their bright, pinkish *Yucca*-like tips alive and vigorous notwithstanding the fact that the original root connection with the ground has long since disappeared. Lower down are *Cassia*, *pacay* (*Inga*), *cherimoya*, the fruits of which some depraved traveler has christened the ice cream of the tropics. Humming birds are particularly noticeable, and parrots and their smaller relatives are also in evidence. The *Eucalyptus* was in

bloom the latter part of July as were innumerable peach trees, and the tall straight gum trunks on the valley slopes suggested, in their slender grace, harp strings on which the gods might well play a pæan of praise to the beauty of Illimani as seen from the southeast. The Indians worshipped the great peaks and well might the discerning traveler.

*Huerta Grande* (beautiful garden), the home of our delightful host, was all its name indicates, and although at an altitude of more than 10,000 feet, the garden was gorgeous with roses, sweet peas, geraniums, hollyhocks, poppies, and forget-me-nots, along with native legumes, *Annonas*, *Agaves*, *granadillas*, small palms, and Chilean pines. There were trees of the so-called English walnut, and of the native South American walnut, the latter removed thousands of miles from its close relatives of the Northern Hemisphere—one of those curiosities of distribution explained only by a knowledge of the geological ancestors of the species involved. Higher up were numerous composites, holly, *Rubus*, *Ephedra*, and at 12,000 feet small *Polylepis* trees were still in evidence.

There is a lower trail southward from Araca which passes several Indian towns on its way to Yaco and Luribay, but we kept on the flanks of the range and, for the most part, not far below the glaciers. Until Araca is reached, the divide is of jagged Devonian shales and sandstones standing almost on end. At Araca the granite comes in and the scenery is indescribably beautiful. The vast snowfields along the crest contribute a glacier to each lateral valley and in each there are one or more lovely glacial lakes at different levels, each with its flocks of gulls. Glacial markings and deposits are very diagram-

matically displayed in each valley but nowhere, neither here nor elsewhere in the Andes, did I observe the terminal moraines of the more extensive glaciers of the past below about 13,000 feet.

Although the Quimsa Cruz, as a mining district, is still in its infancy, there are a number of small mines in operation and considerable development work is being done. All of the mine quarters and mills are above 15,000 feet, and the mines themselves are all still higher—that at Chojñacota being at 16,900 feet and that at Monte Blanco at 17,875 feet. Devonian fossils were abundant and nearly all of my collections in this district came from about 16,000 feet above sea level.

Looking westward from Monte Blanco down the valley of the Soracachi one beholds a sea of salmon and red peaks and ridges. It is a long half-day's ride down to Yaco, where these red beds by their contained fossils reveal themselves of Carboniferous age. It is one of the ironies of fate in this land of great mineral riches and intense cold that the rocks of the Coal Period instead of containing coal are almost entirely of marine origin and are either limestones or more or less gypsiferous red beds. Nowhere are red beds more baffling to the geologist than in Bolivia. Over on the Altiplanicie around Coro Coro they are as young as the Pliocene; farther south around Potosi they contain Mid-Cretaceous marine fossils; and eastward in the vicinity of Santa Cruz de la Sierra they are Permian. Where there is not time to trace out their relationships, or search for their rare fossils, one can only guess at their age, which has been the method of most previous observers.

For two weeks we did not get below 15,000 feet and in this time we skirted the western and part of the eastern

crest of the range. Geologically the two sides are practically alike, but to the east the mists from the Yungas are constant even in the winter season, which is the season of almost continuous sunshine everywhere in the Andes west of the crest of the Eastern Range. On the eastern slopes of the Quimsa Cruz the only time you see the sun is intermittently during June and July and, because of the consequent much greater precipitation, the region is a wild country of snow and ice and crags, enhanced to the imagination by the fact that one rides along in snow squalls and mist, amid waterfalls that are heard but not seen, and with only fleeting glimpses of the great glaciers. The cloud effects are sometimes magnificent as the accompanying view demonstrates.

Traveling eastward down to the indescribably filthy Indian town of Quime, we found that place on the ragged edge of the usual and inevitable *fiesta* with resulting universal drunkenness. Here we encountered our first rain since leaving Panama months before. One must live in a desert for a while to appreciate the blessedness of rain for its purely psychic effect exclusive of its practical benefits. Rain at Quime gave way to heavy snow a few miles farther up and the higher trails were temporarily impassable. There is a good trail down the Quime valley and now that American interests are actively developing extensive mining properties on the eastern slopes of the range, it is to be hoped that American scientists will secure facilities for a biological station in this most interesting and important virgin field. Nowhere can the relations of organisms to altitude and climate be studied to better advantage than in the Yungas of Bolivia, and the height to which the

lowland tropical vegetation surges upward where the moisture is ample is a never-ending surprise.

A great many novelties, both animal and vegetable, are to be found here, not to mention plants of economic value, such as extra fine strains of the orange and coffee of a very superior flavor that never reach the world's markets. The great South American rain forest—the most extensive in the world—surges up the eastern Andean slopes favored by the moisture-bearing trade winds. This rain forest has occupied this area for several millions of years and one may venture to predict that it constituted an animal and plant refuge where yet may be discovered the direct descendants of Tertiary forms. Already we know of Tertiary plants in Chile the progeny of which occurs here. Although the known flora is more diversified than that of any other region of the globe (there are more than 22,000 described flowering plants in the Flora Brasiliensis, and Alfred Russell Wallace estimated that there are probably 80,000 species in tropical South America—a number about equal to that of all other tropical floras of the world combined) it may be conservatively stated that not more than 50 per cent of this flora is known. An apt illustration of this is furnished by the plants which I collected because of their resemblance to the fossil plants found in the Pliocene tuffs of Potosi, nearly all of which proved to be species unknown to science.

The trail to the Yungas passing by Quime to Inquisivi and Suri is not only excellent but fascinating; in the opposite direction it leads out over the Tres Cruces pass to Eucalyptus or Oruro on the railroad. It has been in existence for more than five hundred years. Going over the pass to Coluyo

after fourteen days in the saddle on the heights, we were gladdened by the sound of an automobile and quickly paying off our *arriero*, arranged with the newcomer to be taken to town. We made the sixty-six miles from Coluyo to Oruro in four hours, passing through a country that reminded me of that around Forsyth, Montana, even to a South American substitute for the sage brush of our own western country. Through this more expeditious mode of travel we saved two days.

Tres Cruces is a broad saddle of Devonian shales about 16,000 feet in altitude, but with no high peaks near at hand or even visible, and with a gradual descent to the westward. The country is more arid than is that a few miles to the northward, and the trinity of peaks that crown the Santa Vela Cruz to the east have no permanent ice cap.

Like all of the great mountain ranges that have figured in human history the Andes are very young—geologic, biologic, and physiographic evidence is at one in confirming this statement. I shall give but a single instance among the many of the sort of evidence that the geologist relies upon in making such an assertion. On a high pampa in the Sierra de Cochabamba I found sediments that had been deposited in a small Pliocene basin. Much of the material was volcanic ash the only known source of which was many miles away in the great volcanic field of the western Andes. This ash deposit, partly wind blown and partly water laid, had buried the fruits and leaves of trees the near relatives of which are to be found at the present time only in the Yungas—not far away to be sure, but at much lower levels, and not extending upward more than half way to the 11,800 feet where the fossils



were found. Hence it is inferred that these fossiliferous sediments have been uplifted more than a mile since the fossil trees lived in that region, and knowing that the latter are Pliocene in age, we get the minimum measure of the amount of uplift since Pliocene times.

It had been supposed that this uplift was of a great segment of the earth's crust with bounding fractures or faults on the two sides. At any rate it was responsible for the anomalous climate that prevails in this region at the present time—the arid upland, the semi-desert of the Peruvian coastal region and the nitrate desert of northern Chile. This is shown in many ways, as for example at Potosi, where the terminal moraines of former glaciers are found at about 13,000 feet and where Potosi's silver mountain, although reaching upward to more than 15,000 feet, carries no permanent snow because of the dearth of precipitation.

Formerly a rain forest like that of the Amazon Basin extended across the site of the Andes to the Pacific coast, and probably beyond, for there is some geological evidence that the deeps found immediately west of the present coast were once land, which has since sunk on the seaward side of the great fault that runs along this part of the

present coast. Relics of this former rain forest have been found in the rocks of both Peru and Chile, and traces of it are preserved at a number of localities in the arid uplands of Bolivia.

The slow rising of these great mountain ranges across the equatorial zone in the path of the trade winds was a dramatic episode in the history of the earth—one that it would have been fine to have witnessed, although probably the rise took place with such slowness as not to have been perceptible within the proverbial threescore and ten years allotted to man. It occurred so recently, however, that not yet has the kinship been obliterated between the plants or the birds on the two sides of the Cordillera, in those regions like Colombia, where no strongly contrasted climatic change was set up on the two sides.

It is one of the fascinations of palæontological studies that such large and inspiring problems are pressing for solution. Although the results of such studies seldom admit of a mathematical demonstration, the main outlines emerge surely, as do those on a great canvas under the hand of a master painter. It is not surprising that the votaries of palæontology wonder why all men do not aspire to become palæontologists.



M. M. Glidden



"ROSE CITY"

Rose City—the locality of the fall—is the name that has been given to the new aërolite or stony meteorite from Michigan, the largest fragment of which, nine inches long, has been lent to the American Museum by Mr. P. W. A. Fitzsimmons and is here depicted in side view.

A dull skin covers much of the surface; the deep pits are due to superficial melting while in the air. The agglomeratic character of the mass is also recognizable.

The fragment is on exhibition on the first floor of the American Museum



# A New Meteorite from Michigan

By EDMUND OTIS HOVEY

Curator of Geology and Invertebrate Paleontology, American Museum

METEORS, or shooting stars, are seen by the thousand in Michigan, as they are elsewhere in the world, but only three meteorites have been described from the state: one from near Reed City, another from Grand Rapids, and the third from Allegan. "Reed City" is an iron meteorite weighing about 43 pounds which was plowed up in a field near the town. "Grand Rapids" is a mass of iron weighing 114 pounds which was unearthed in making the excavation for a building. "Allegan" is the only one of the three which was seen to fall. It is a stony mass which weighed about 70 pounds when it struck the earth on Thomas Hill on the Saugatuck Road in Allegan, at about 8 A.M. on July 10, 1899.

Much interest, therefore, was aroused by newspaper accounts of a brilliant meteor that was seen to pass from north northwest to south southeast over the northeastern portion of the Lower Peninsula of Michigan, about eleven o'clock in the evening of October 17, 1921. The heavens were illuminated over an area thousands of square miles in extent. Near Rose City, Ogemaw County, the meteor exploded with the usual accompaniment of several loud reports, and three of the fragments into which it burst have been recovered on the premises of Mr. George Hall, about nine miles northeast of this little hamlet, which gives its name to the fall. These portions, it is stated, weighed about three and one-fourth pounds, seven pounds, and thirteen pounds respectively, when discovered. They are now the property

of Mr. P. W. A. Fitzsimmons of Detroit, who has very kindly lent the largest mass to the American Museum for exhibition.

The newspapers gave their customary vivid accounts of the occurrence, from which we may select the following:

The night the meteor fell buildings in Rose City shook and the effect was similar elsewhere in northwestern Michigan. At Caro, nearly 100 miles away, it was said the sky-traveler woke folks up, and Saginaw also reported a startling effect. The meteor attracted attention as far south as Detroit and Albion.

The flaming heavenly torch appeared to be eight feet in diameter, as it swished through space, apparently directly over the village of Rose City.

A tail of light streamed in the path of the falling body for a distance of at least 100 feet. There was a beautiful purple light encircling the outer mass of fire, and a shock followed by the rattling of windows and trembling of buildings was plainly felt for 30 seconds as the massive flaming mass struck the earth.

A man who was camping about fourteen miles from the George Hall farm gave Mr. Fitzsimmons an account of the meteor in nearly the following words:

I was sleeping in my tent that night and all at once I saw things very light outside. I quickly looked out and saw high in the sky, about five miles I should think, a large ball of fire and this looked to me as large as an ordinary barn. After the ball had traveled on its way, and the light had died out, I heard three loud explosions, one immediately following the other.

It seems that Mrs. George Hall was up rather later than usual, as her husband had been ill, and thus had an opportunity of witnessing the fall. Mr. Fitzsimmons reports her account of the event as follows:

I saw it very light out of doors and heard a roaring sound and then three loud explosions. I thought it was an airship and it was dropping some bombs or something of that character. I jumped up and ran to the door, and the big light was disappearing in the south. The roaring itself was not so very loud, but the explosions were very loud indeed, and while I stood in the doorway watching the disappearing light, I distinctly heard a sound like fine singing.

The largest fragment, which is about nine inches long, was found the next day forty feet south of the house, embedded about two feet below the surface in soft, sod-covered earth. By so narrow a margin did Mrs. Hall and her husband escape serious accident! The next piece in point of size was found later in the same day about 150 feet from the house, near a highway. It was not so deeply buried in the ground as was the first.

The meteorite is black in color, both on the surface and in the interior. It is deeply pitted and it presents a dull black skin over much of the outside, both features being due to surface melting caused by friction with the air during the last stage of its journey to the earth. One of the most peculiar features of the mass is that it looks somewhat like a conglomerate with rounded protruding knobs of relatively coarse material cemented together by duller fine material of the same nature.

Because of its origin and because there is no evidence of the action of water in connection with either the knobs or the cement, the material is called an "agglomerate" rather than a conglomerate. When the specimen was received at the American Museum, many of the surface pits contained grass, grass roots, and soil which were firmly wedged into them. The grass had not been burned or even charred and therefore the temperature of the meteorite when it struck the ground could not have been elevated.

Examination of the surface of this meteorite reveals the presence of minute specks of metallic iron in the midst of a stony matrix, which is a feature shown by almost all our stony visitors from space. A polished section shows not only innumerable particles of this character but also strings and irregular areas of metal. Chemical analysis discovered the presence of about 17 per cent of metal mixed with 83 per cent of mineral in the meteorite, while further tests showed that the metal was made up of about 91 per cent of iron and nearly 9 per cent of nickel and cobalt. The use of the microscope determined that the stony portion was composed principally of the two minerals, enstatite and olivine. The material furthermore is somewhat porous or spongy in texture. This is due to the presence of innumerable minute cavities which, under the magnifying glass and still better under the microscope, are seen to be angular in shape and to be lined with crystals of the minerals which make up the ground mass.

## NOTES

### MUSEUM OF THE AMERICAN INDIAN, HEYE FOUNDATION

Although the Indian is a member of a vanishing race, he lives and will live forever in the narratives of the Jesuit fathers, in the pictures and pages of Catlin, in Schoolcraft and Parkman, and a host of others. Place names throughout the length and breadth of the land perpetuate his memory in musical polysyllables, and his traditions have become part of the heritage of the later-day descendants of the alien conquerors of his lands. Yet, in spite of the widespread interest in the aboriginal inhabitants of the Americas, there was no institution devoted exclusively to the anthropology of the indigenous peoples until Mr. George Gustave Heye brought to fulfillment a splendid vision to which he had been steadfast for many years.

The Museum of the American Indian—Heye Foundation, which was opened on November 15, 1922, marks the culmination of twenty years of planning and collecting, in which Mr. Heye had the coöperation of many noted workers in the field of anthropology and the financial support, supplementing his own generous provisions, of the trustees of the museum and interested friends. Although almost two decades elapsed between the inception of the plan and its fulfillment—decades during which the two continents and the islands of the Western Hemisphere were scoured for exhibition and study material—the published results of studies made by members of the staff of the museum, numbering no less than ninety titles and including monumental contributions like *The Antiquities of Manabi, Ecuador*, by Professor M. H. Saville, have enabled the public to gauge the magnitude and diversity of the research work undertaken by the institution. No fewer than twenty-one names of anthropologists engaged in collecting and in study among different Indian tribes or in archaeological work on the sites of former Indian occupation, are recorded in the pamphlet setting forth the aims and objects of the museum, and the work of several of these anthropologists in particular areas has stretched over many years, witness the exhaustive researches of Professor Saville on the west coast of South America and in Central America, the collecting of Mr. M. R. Harrington in the United States, and the excavation, by Mr. F. W. Hodge during the last five field seasons, of Hawikuh, one of the famed "Seven

Cities of Cibola," the reputed riches of which lured Coronado and his gold-hungry followers into the sun-scorched desert of the Southwest.

The excavation of the last-mentioned site was made possible through the generosity of Mr. Harmon W. Hendricks, a trustee of the museum, and one to whose benefactions it owes much. To list all of those who through gift and encouragement supported Mr. Heye in his undertaking, is not possible within the limits of this note, yet mention must be made of Mr. James B. Ford, one of the trustees, who has been the generous patron of much of the research in the countries to the south, in addition to enriching the collections of the museum; of Mr. Miner C. Keith, a trustee, who presented to the museum the largest collection extant of Costa Rican earthenware; of General T. Coleman du Pont, who financed the expedition to Kane County, Utah, for the exploration of an ancient site of the so-called Basket-makers; of Mrs. Marie Antoinette Heye, who for many years gave Mr. Heye's undertaking most generous support; of Mrs. Thea Heye, who has been the donor of hundreds of valuable objects; and of Mr. Archer M. Huntington, who presented the ground upon which the museum edifice has been erected and who in 1919 inaugurated the series of *Indian Notes and Monographs* in which have been published no less than sixty-five listed contributions.

Between a million and two million specimens representative of the culture of the Indians have been assembled through the activities of the museum, including many thousands that are unique. The three floors devoted to exhibitions naturally do not permit the presentation to the public of more than a fraction of this vast total, but even though it is only a fraction, it will go far toward satisfying the most exacting requirements of the lay visitor. Students will be afforded every facility for utilizing the study collection in their researches.

### THE CLEVELAND MUSEUM OF NATURAL HISTORY

The Cleveland Museum of Natural History, which began its existence only about two years ago, has already abundantly demonstrated its ability through exhibits, lectures, and library facilities to respond to the needs of the community which it serves. Late in October of 1922 it even opened its own printing plant, from which was issued under date of No-

vember 1 the initial number of the Cleveland Museum *Bulletin*. From that publication we learn of the work which the museum is doing and of the loyal support which it is receiving from the people of Cleveland. It is stated that through a recent gift from Mrs. Dudley S. Blossom of the Herbarium of the late Samuel Hart Wright of Penn Yan, New York, the museum has come into possession of approximately 10,000 specimens of plants, representing a number of the American and European genera. Mrs. Blossom's gift includes also a part of the Wright library of scientific books, many of which are out of print. Another acquisition deserving special emphasis is a collection of thirty-seven water color studies of the fur seals of the Pribilof Islands, painted by Henry Wood Elliott during his visits to the islands in the early seventies. For this donation the museum is indebted to Mr. John M. Henderson.

During the months of October and November nearly forty lectures were given by members of the museum staff, and certain additional lectures were delivered by invited speakers. The museum staff has been carrying the message of the institution beyond its walls by lecturing before clubs, schools, churches, and conventions, in addition to addressing audiences within the museum itself. Another evidence of the service the museum is rendering to education is the completion by its librarian, Miss Lindberg, of an annotated list of books on natural history suitable for children in their early 'teens or younger.

The museum is housed in Euclid Avenue in one of the Hanna mansions, which has been acquired for a period of years. Two rooms in the present edifice have been completely renovated and in them have been installed natural history exhibits of rare attractiveness. The collections of birds, mounted by Mr. Arthur B. Fuller, are particularly noteworthy for their excellent taxidermy. The Old-World birds, collected and presented by Mr. K. V. Painter, are one of the features of the museum.

#### THE FIELD MUSEUM

EXPEDITION TO SOUTH AMERICA.—Dr. Wilfred H. Osgood, curator of the department of zoölogy, Field Museum, and Messrs. C. C. Sanborn and H. B. Conover, of the division of birds in that institution, recently left Chicago for Chile, to penetrate some of the comparatively little-known regions of that country, including the area held by the Araucanian Indians.

After landing at Valparaiso, the members of the expedition plan to go to central Chile and thence to proceed southward as far as Chiloe Island. Doctor Osgood and Mr. Conover will then work across northern Argentina and into southern Brazil and Uruguay, returning probably about the middle of 1923. Mr. Sanborn, on the other hand, will remain in the field throughout the present year. He will move northward as the season advances, collecting in northern Chile and Argentina and in Bolivia.

The expedition will visit many of the localities of historic interest to zoölogists, including the type localities of animals collected by Charles Darwin during the voyage of the "Beagle." The expedition will devote itself to the general collecting of vertebrates. Among the animals of popular interest regarding which the party of scientists hopes to learn much is the chinchilla, now so rare because of its inordinate use as a fur. Another expectation which they will strive to realize is to bring back to this country the first specimens of the pudu, a very small deer, and one of the rarest in the Americas.

EXPEDITION TO HONDURAS.—Mr. Karl P. Schmidt, until recently assistant curator of herpetology in the American Museum and now assistant curator of reptiles and batrachians in the Field Museum, left New Orleans about the middle of January for Belize, British Honduras. Mr. Schmidt's primary purpose in undertaking this expedition, in which he is accompanied by a taxidermist, is to secure for the Field Museum material to be used for habitat groups of amphibians and reptiles as well as specimens for the systematic series of these animals. Mammals and fishes will also be collected. After a short stay in British Honduras, Mr. Schmidt and his companion will proceed to Puerto Cortes, Honduras, and thence to Lake Yojoa in the interior of the state. Honduras is perhaps the least-known, zoölogically, of the Central American countries and important results may, therefore, be anticipated from this expedition.

#### ASIA

WHAT THE GOBI DESERT HAS YIELDED.—In a cable sent by Mr. Roy Chapman Andrews to *Asia* and published in the December issue of that magazine, the leader of the Third Asiatic Expedition summarizes the remarkable results obtained from five months' work in the Gobi Desert. These include the discov-



ery of vast fields rich in Cretaceous and Tertiary fossils. The specimens obtained include not only the huge skull and portions of the skeleton of *Baluchitherium*, the largest known land mammal, which arrived at the American Museum toward the close of December, but also complete skeletons of small dinosaurs and parts of large dinosaurs; skulls of rhinoceroses; skulls, jaws, and fragments of mastodons, rodents, carnivores, horses, insectivores, and deer. Fossil insects and fish, in a fine state of preservation, were also found. Extensive deposits of Devonian, Carboniferous, and Permian age, hitherto unknown in Mongolia, were located, as well as a vast series of Pre-Cambrian and Palaeozoic rocks. The expedition mapped a strip a thousand miles square in the type region of Mongolian geology and obtained 20,000 feet of film illustrating in full detail the work of the expedition, the life of the natives, and the behavior of the herds of antelopes and wild asses that were seen. A representative collection of the mammalian fauna of the region was obtained.

#### BIRDS

**BIRD COLLECTING IN PERU.**—Mr. Harry Watkins, who is conducting a biological survey on behalf of the department of birds, American Museum, to determine the relation between the avifauna of the coast of southwestern Ecuador and that of the Marañon Valley of Peru, reports the discovery of heretofore unsuspected areas of forest land on the western slopes and even on the summits of the Andes between Paita and Huancabamba. Through his capture in this region of motmots and trogons, the known range southward on the Pacific coast of these genera is considerably extended. The abundance of the bird life in the region is evidenced by the fact that already more than one hundred species are represented among the specimens taken by Mr. Watkins.

#### MAMMALS

**A COLLECTION FROM ECUADOR.**—Messrs. G. H. H. Tate and H. E. Wickenheiser are on their way to New York with a good-sized collection of mammals made in the Guayas Basin and in the central Andes of Ecuador. The collecting and field observation in the areas covered will prove a valuable supplement to the work already done by the American Museum in this South American state. Both Mr. Tate and Mr. Wickenheiser have

been suffering from malarial fever but according to reports recently received have recovered from their indisposition.

#### ANTHROPOLOGY

**AZTEC RUIN.**—Although interesting discoveries have been made from time to time in the course of excavating the pueblo known as the Aztec Ruin, New Mexico, the kind of ladders or steps whereby the ancient inhabitants of this settlement climbed from story to story remained undetermined. At first it was the impression of Mr. Earl H. Morris, who heads the Archer M. Huntington Archaeological Survey of the Southwest, that the ladders must have been composed of pairs of heavy poles set side by side and alternately notched, but after two hundred chambers had been freed of their contents and not even a fragment of such a ladder unearthed, he abandoned this assumption and had no alternative suggestion to offer.

Recently, while he and his assistant were digging in one of the rooms of the ruin, the latter came upon an object unlike anything that had previously been excavated. By eleven o'clock at night their joint efforts had succeeded in bringing to the surface a number of pieces of worked wood and several poles, which, when assembled, revealed themselves as parts of a ladder of unique construction. The sidepieces of this ladder were straight, barked cedar poles,  $6\frac{1}{2}$  feet long, that tapered from a diameter of  $2\frac{1}{2}$  inches near the base to  $1\frac{3}{4}$  inches at the upper extremity. Laid along each of these poles was a slender skunk-bush sapling that was lashed to its support by transverse with bindings. The ends of the rungs were thrust between the cedar sidepieces and the parallel saplings, each rung above a pair of opposing lashings. The saplings were necessarily bent away from the timbers to which they were bound to permit the insertion of the rungs, and being of tough resilient wood, thereafter exerted a pressure which under ordinary circumstances held the crosspieces securely in place. The saplings extended beyond the ends of the sidepieces and their free extremities were bent inward toward each other and bound together, thus forming a curved top to the ladder. Thereby the ladder was prevented from spreading apart and a bail-like handle was provided by which this light yet strong and convenient device might be lifted and drawn up into the room above. The rungs of the ladder, five

in number, were round sticks of hard wood about  $1\frac{1}{4}$  inches in diameter, each smoothly polished by the wear of bare as well as sandaled feet.

EUROPEAN ARCHAEOLOGY.—As a result of President Henry Fairfield Osborn's visit to Europe in 1921, the department of anthropology of the American Museum this year renewed its effort to complete its Old-World archaeological collections. Associate curator N. C. Nelson, who has charge of these collections, and who was in Europe for a similar purpose in 1913, returned early in December, 1922, after a six months' search, to report the acquisition of about 3000 new specimens and to explain that the way is open to acquire as many more. He brought back also about 100 photographs of archaeological interest, as well as extensive notes on the principal prehistoric collections exhibited in the museums of western Europe.

Mr. Nelson's travels took him to England, Denmark, Germany, Switzerland, Holland, Belgium, and France. He visited more than 40 public museums, besides 20 important private collections; examined and photographed, for the first time, 19 more or less famous archaeological stations; and called upon more than 100 people directly or indirectly interested in archaeology. Exceptional opportunity for observation was afforded him in that he was invited to accompany a group of French and Belgian archaeologists and geologists on a tour of inspection to several important archaeological stations in England, Holland, and Belgium. In this way he was enabled not only to see for himself how the specimens occur, but he also learned of the various methods employed in their excavation. The kindness and hospitality enjoyed in this connection, with the insight afforded into real European home life, Mr. Nelson says, will long be remembered with gratitude.

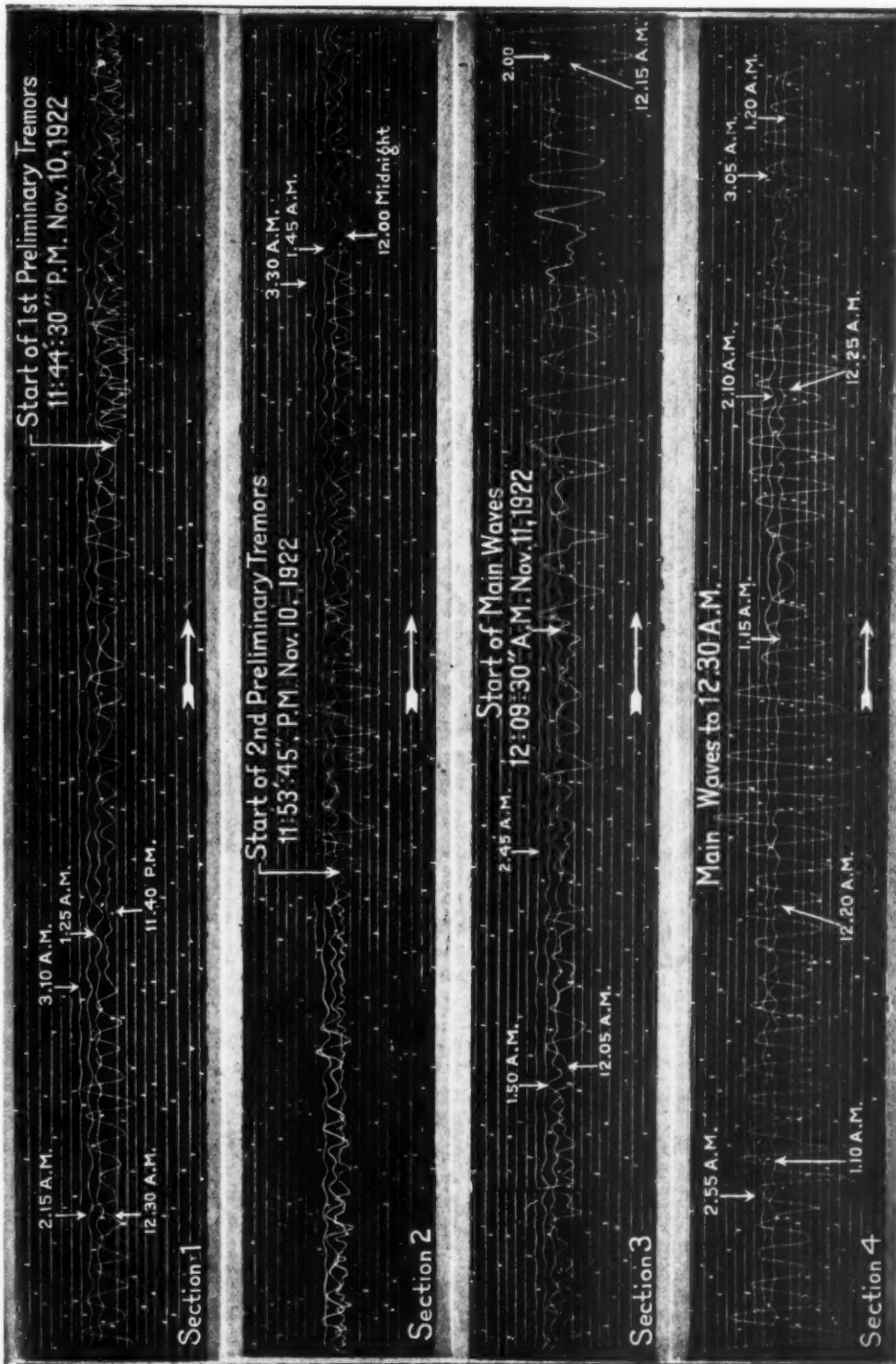
Regarding the general progress of archaeological investigation in Europe, Mr. Nelson seems very hopeful. Many able workers were lost during the war and funds are everywhere limited or lacking. Nevertheless, those who remain are unbounded in their enthusiasm, and more or less work has been done everywhere, both during and since the war, that is of the highest importance. In certain quarters—as, for example, in England and Switzerland—discoveries have been made which promise to modify very considerably the present views of prehistoric development.

### THE CHILEAN EARTHQUAKE

Though rivaled in destructiveness by the death-dealing instruments of war, the earthquake, manifesting its might without warning and defying control, will doubtless continue at intervals to topple down cities, even after an era of peace and good will has ushered out, as we trust it may, the troubled centuries of man-made strife.

There have been a number of earthquakes more cataclysmic than the Chilean earthquake of November 11, 1922. That of Lisbon in 1755 killed between 30,000 and 40,000 people; in the Kangra earthquake of India, in 1905, nearly 20,000 individuals perished; the total loss of life in the Messina earthquake of 1908 was, according to official returns, no less than 77,283. Yet the 800 or more men, women, and children who were killed by the Chilean earthquake do not measure the magnitude of this phenomenon, which, had it occurred in a more densely settled area of the globe, would doubtless have taken a greater toll of life. The earthquake and the resulting tidal waves affected the coast of Chile over an extent of 1200 miles, that is, from Antofagasta on the north to Valdivia on the south.

The record of this earthquake, as registered on the seismograph of the American Museum, is reproduced on the opposing page in four sections, each of a duration of about thirteen minutes, as indicated by the dots. The sections should be read consecutively from below upward, beginning with the section on the left, at the point marked "Start of 1st Preliminary Tremors." It should be explained that these four sections represent convenient subdivisions of a continuous band of smoked paper that revolves on a cylinder of the seismograph. In the course of a complete revolution the band moves to the right one space and the recording needle, which is one of the essential features of the seismograph, thereupon traces the waves of the second and subsequent circuits alongside the earlier part of the record. Three sets of such waves are shown on each of the sections depicted, those on the right of each section being earlier than any of the middle series, and those on the left representing the final stage. In reading the record, one should, therefore, after tracing the first line of waves through the successive sections, turn back to the first section and resume the story in the second line of waves, and so on through to the concluding phase.



THE RECORD, FROM THE SEISMOGRAPH IN THE AMERICAN MUSEUM, OF THE CHILEAN EARTHQUAKE OF NOVEMBER 11, 1922

The first preliminary tremors (see section 1) arrived at the seismograph in the American Museum about a quarter of an hour before midnight on November 11 and lasted for about 9 minutes and 15 seconds, when the second preliminary tremors (see section 2) set in and continued for 15 minutes and 45 seconds. The main waves (see sections 3 and 4) started 9½ minutes past midnight and remained prominent for about 21 minutes. At 1 A.M., however, the needle still registered waves of considerable intensity, which continued to 3 A.M. Although the quake lasted only the fraction of a minute at its point of origin, the record on the seismograph was spread over more than three hours of time. This spreading out of the three kinds of waves on the record is a measure which the observer uses in calculating the distance of the point of origin from the seismograph. The shorter the time of the first and second preliminary tremors, the less the distance to the point of origin.

In the bulletin posted on the morning of November 12 by Dr. Chester A. Reeds, the observer in charge, the distance was estimated to be 7900 km., or about 4937 miles. The correctness of this estimate is borne out by the fact that Coquimbo, near the center of the disturbed area, is 7900 km. due south of New York City.

This is the second time during a period of less than twelve months that the seismograph in the American Museum—the gift of the late Emerson McMillin—has been of service to science in recording data regarding an earthquake of major importance.

#### ARTHUR WESLEY DOW

Professor Arthur Wesley Dow, director of the department of fine arts, Columbia University, died on December 13, 1922. Not only an artist and author of recognized creative power, but a man of very fine personality, Professor Dow left an indelible impression on those with whom he came in contact and upon the art of the nation. He possessed preëminently the ability to awaken the creative impulse in others, his students responding to the magic of his influence in producing original designs of great beauty.

He was born at Ipswich, Massachusetts, in 1857, and was the son of David F. and Mary P. Dow. After completing his academic and classical education at Ipswich, he studied art in Boston, and in Paris under Boulanger and Lefebvre. His paintings were exhibited

in the Salon, Paris, in 1886–87, and again in 1889, receiving honorable mention. In the company of the artist Fenollosa, he made a thorough study of the art of Japan, and his work after his return to this country showed the Japanese influence. He was for years the curator of Japanese art, Museum of Fine Arts, Boston. He was instructor of art, Pratt Institute, Brooklyn, from 1895 to 1904, leaving it to become the director of the fine arts department, Columbia University. The inspiration he brought to Pratt Institute, having its center in the art department, was felt throughout the Institute, all departments responding to the art impulse which he had so deeply stirred. During this period he made a special study of the art of the North American Indian, visiting the American Museum frequently to study the Indian exhibits. In his lectures he frequently made reference to the wealth of material at the Museum, assigning to his students problems in art which necessitated their careful study of the dress, pottery, basketry, etc., of the Indians and the originating of designs with Indian motifs. He was a friend of Frank H. Cushing, who lived among the Zuni Indians as an adopted member from 1879 until 1884, and who upon his return to the eastern states, visited Professor Dow at Ipswich and located there the site of an old Indian spring, all traces of which had been obliterated. Digging on the site revealed ancient Indian pottery.

At Columbia University his work broadened out and expanded, many thousands receiving his message and carrying it to different parts of the country. He was lecturer on art at the Art Student's League, 1897–1903, and for years director of a very interesting and live summer art school at Ipswich, Massachusetts. He was the author of a widely known book, *Composition*, richly illustrated; of *Ipswich Prints*; and *Along Ipswich River*.

#### INSECTS

THE GYPSY MOTH IN NEW JERSEY.—The citizens of New Jersey may congratulate themselves upon the vigor with which war has been made upon the gypsy moth (*Porthetria dispar*) that menaced certain areas of that state. Through appropriations made by the federal government, by the New Jersey legislature, and by individuals like Mr. Duke, on whose estate there was a heavy infestation, the work of extermination, which has now been in progress for two years, was made possible, and



the results attained should be a matter of pride to those who have given their energies to combating this insect pest. With what painstaking thoroughness the work of extermination has been pursued may be inferred from the fact that although during the first year of the campaign more than 3,000,000 egg masses were found, only 909 were discovered during the second year. This startling reduction in numbers acquires added significance through the fact that in the second year 1400 square miles of territory were scouted as against 894 in the first year. The actual number of trees examined in the second year was 2,025,403 as against 1,157,339 in the previous twelve-month, and when the fact is stated that some of these trees were in dense thickets, the difficulties confronting the careful scouting that is required may be visualized. Creosoting, spraying, and banding, were among the methods of attack again employed during the past year.

The reduction in number of discovered egg masses from more than three million to less than one thousand might seem to justify a relaxation of effort, but it is to be hoped that such false economy will not be practised. Only after unrelaxed vigilance over a period of years can one say with some degree of certainty that the danger is eliminated. Mr. Weiss, chief of the Bureau of Statistics and Inspection, New Jersey State Department of Agriculture, writing in the fall of 1920, at the very inception of the campaign against the gypsy moth,<sup>1</sup> estimated that it would probably require from three to five years before assurance could be given that the pest had been cleaned up. He added that in case it should be found in the Watchung Mountains—a region where spraying is carried on with great difficulty—the work of extermination would require more time and effort. During the past season a few egg masses were located in the Watchung, suggesting dangerous consequences if, as a result of the marvelous strides already made, the public permits itself to be lulled into a false sense of security. The work should go on with full financial support until all danger is removed.

#### LOWER INVERTEBRATES

**WORK ON THE SHELL COLLECTION.**—Mrs. Ida S. Oldroyd, of Stanford University, one of the foremost students of mollusks in this country, has been spending three months at the American Museum revising and bringing up to date the nomenclature of the shell

collection of the department of lower invertebrates. At least 200,000 shells, representing about 10,000 species, are in the possession of the department. Mrs. Oldroyd has been giving her attention to the marine gastropods (sea snails) of the collection as well as to the bivalves or two-shelled mollusks.

**ADDRESSES BY DR. ROY W. MINER.**—"Life's Victors, or Why the Fittest Survive," was the subject of an address delivered by Dr. Roy W. Miner before the Academy of Natural Sciences in Buffalo. Doctor Miner also spoke before the Rotary Club of North Adams, Massachusetts, on the American Museum of Natural History and its activities. Subsequently, on December 15, Doctor Miner lectured on evolutionary subjects before the University School of Cleveland and before the University Club of that city.

#### SPECIAL EXHIBITS

**CAMERA CLUB EXHIBIT.**—Photographic records of animal life are invaluable in natural history study, yet in our admiration of the exquisite results that such photographs present, we are too apt to overlook the technical processes whereby they have been made possible. The exhibit of mammal photographs in the American Museum last summer showed what nature photography has accomplished. Another exhibit of photographs, which was installed by the Camera Club of New York in the hall of woods and forestry early in December, remaining there throughout the month of January, illustrated the striking effects attained by different printing processes. The quality of the pictures may be gauged by the fact that of the 192 shown, about half had received recognition in different salons in this country and abroad.

Although the subjects depicted ranged over a field more extensive than natural history, two conspicuously placed portraits—that of Mr. Carl E. Akeley and that of Mr. Vilhjalmur Stefánsson—and certain other photographs, like that of the Museum itself, had a special interest for friends of the Museum in addition to that which they possessed as examples of different photographic methods.

Those not versed in the technique of photography had cause to wonder at the number and variety of the processes illustrated in the exhibit. There were examples of the bromide process, which is employed almost universally for enlarging; of a process resembling the bromide and known as the Artatone; of the carbon process; of the gum process, which

<sup>1</sup>NATURAL HISTORY, Vol. XX, p. 500; see also NATURAL HISTORY, Vol. XXI, pp. 103-04, 647-48



involves the same kind of chemical action as the carbon process but in which gum arabic is used instead of gelatine to hold the pigments. Great skill is required in the use of the gum process, which gives broad, sketchy effects. A process which, like the one just mentioned, is a vehicle of expression for the artist photographer, is the oil process, in which unlimited scope is given for the production with brush and pigment of individual effects; a similar process is that known as the bromoil. By the platinum process a beautiful, clear, flat image is produced, that is devoid of luster. Due to the demands for platinum during the war, the manufacture of platinum paper almost ceased. Other processes represented in the collection of pictures were the gum platinum, the palladium, the gum palladium, the chloride, the Kerotype transfer, and—regarded by many as the most beautiful process of all—the bromoil transfer.

Different kinds of apparatus and instruments used in photography were also represented in the exhibit, including the camera known as the Naturalist Graflex, designed especially for photographing mammals and birds in the wild state where long focus or telephoto lenses are required.

**BASKET WORK BY AN INSTITUTIONAL CLASS.**—In the hall of woods and forestry, American Museum, there was shown during December an exhibit of baskets, dainty in workmanship and perfect in symmetry,—the product, one would have said, of skilled fingers directed by an attentive mind. Yet the baskets were made, not by professional workers in wickerware, but by the Institutional Class of Public School 9, the Bronx, at the Shelter of the Bronx County Society for the Prevention of Cruelty to Children. Here boys and girls that have some defect of character that they are unable to overcome unassisted, are given a new grip upon themselves, and a new vision, through the course in character-building conducted by Miss Lucy C. Simonson. To the baskets were attached bright and helpful little verbal hints how happiness may be gained through giving cheer to others,—an indication that the making of the baskets, however worthy in itself, was incidental to the larger task of giving these children a new ideal and inspiring them to achieve it.

#### MEETINGS OF SOCIETIES

**NATIONAL ASSOCIATION OF AUDUBON SOCIETIES.**—On October 30 a public meeting

under the auspices of the National Association of Audubon Societies was held in the American Museum, in the course of which illustrated addresses on "The New Era in Wild Life," "Bird Photography, Past and Present," and "Comments on Bird Protection in Europe and America," were delivered respectively by Mr. Ernest Thompson Seton, Dr. Frank M. Chapman, and Mr. T. Gilbert Pearson.

On the day following, the National Association held its eighteenth annual meeting. President Pearson announced that a gift of \$200,000 cash had been received during the year, to be known as the "Permanent Fund of 1922." He further stated that the donor, whose name he was not at liberty to divulge, stipulated that this gift should be preserved as an endowment fund, the interest from which was to be used for the following purposes:

"First, for the education of the general public in the knowledge and of useful, beautiful, and interesting forms of wild life, especially birds.

"Second, for the actual protection and perpetuation of such forms of wild life on suitable breeding and other reservations.

"Third, for protecting and maintaining adequate protection for such forms of wild life in all parts of the Western Hemisphere.

"Fourth, or for any one of these purposes."

At the meeting Dr. Frank M. Chapman and William P. Wharton were reelected as members of the Board of Directors for a term of five years, and Mr. George Finlay Simmons of Austin, Texas, was chosen to fill the place on the Advisory Board of Directors left vacant by the death of Mr. Howard Eaton of Wyoming.

**NATIONAL ACADEMY OF SCIENCES.**—Among the papers presented at the autumn meeting of the National Academy of Sciences, November 14-16, were several contributed by members of the scientific staff of the American Museum, or by those closely associated with the undertakings of that institution. Professor Charles P. Berkey, who as geologist of the Third Asiatic Expedition participated in the interesting discoveries made in Mongolia, spoke on "A Tentative Geological Column for Central Mongolia." Dr. Clark Wissler, in unfolding his subject, "Dating Prehistoric Man in America by Methods of Distribution and Stratigraphy," gave a brief report upon studies carried on in the Museum from which has been developed a technique for estimating

the relative antiquities of prehistoric remains by comparing their geographical distributions. "The Restoration of Fossil Human Remains: Its Possibilities, Value, and Limitations," was the subject discussed by Dr. J. H. McGregor.

In a paper entitled "Probable Mutation in the Genus *Buarremon*," Dr. Frank M. Chapman expressed his belief that the presence or the absence of the black band across the breast, which distinguishes certain species of this genus of birds, is due to mutation. The theory was advanced that these pectoral bands, which, together with many other markings, like bars on the wings, stripes on the crown, or spots on the outer tail feathers, are present in many wholly unrelated species of birds, will be found to be unit characters which appear or disappear through the action of internal rather than external, or environmental, causes. Dr. Robert Cushman Murphy's paper "The Whitney South Sea Expedition of the American Museum of Natural History," was presented by title.

Dr. Frank E. Lutz presented, on behalf of himself and his co-investigator, Prof. F. K. Richtmyer, a paper entitled, "Ultra-violet Flowers and Their Possible Bearing on the Problems of Pollination by Insects." In it he pointed out that as certain experiments indicate that insects respond definitely to ultra-violet rays, it would seem that in considering flower colors in connection with pollination by insects, attention should be given not only to the visible spectrum but also to the ultra-violet, the reflection of ultra-violet rays by certain flowers having been established in the course of experiments conducted last summer at Boulder, Colorado, by Doctor Lutz and Doctor Richtmyer.

In his address regarding "Recent Discoveries of Fossil Vertebrates in China and Mongolia," Dr. W. D. Matthew dwelt on the significance of the finds made last summer by the Third Asiatic Expedition. Central Asia has been among the least-known regions of the world in respect to the history of its land fauna. The area is of peculiar interest because of the belief that land vertebrates of other regions were evolved in Asia and spread thence. The discoveries made by the Third Asiatic Expedition have indicated the existence of series of extinct faunas in Mongolia which will provide the necessary evidence to settle this problem.

AMERICAN GAME PROTECTIVE Association.  
—The Ninth National Game Conference of

the American Game Protective Association took place in the roof garden of the Waldorf-Astoria Hotel on December 11 and 12. Scientists, game wardens, and others interested in the enforcement of conservation laws were in attendance from every part of the United States, as well as from Canada and Mexico. The American Museum was represented by Mr. H. E. Anthony, associate curator of mammals of the Western Hemisphere, who presented a paper on "Some Aspects of the Close of the Age of Mammals," based on the article entitled "Can We Save the Mammals?" the joint contribution of Professor Henry Fairfield Osborn and Mr. H. E. Anthony to the September-October issue of NATURAL HISTORY.

Much attention was given at the gathering to the then pending New-Anthony Bill, for which support was solicited. The object of this Bill is two-fold: first, to provide chains of resting and breeding grounds where migratory game birds will be free from molestation on their fall and spring migrations; and secondly, to provide for people who do not have access to private preserves, places where they can shoot the ducks, geese, and other game birds in the proper seasons and under suitable regulations. Under the terms of the Bill a dollar license will be required of every one who hunts migratory game birds. The proceeds from the sale of these licenses will, according to the provisions of the Bill, be applied in part to the purchase of public game-bird refuges, in part to the enforcement of the Migratory Bird Law and the protection of the areas set aside for the birds. Due to the progressive draining of swamps, the feeding and resting grounds of the birds are already all too few in certain parts, and the acquisition and permanent maintenance of still undrained areas should assure the birds a chance for existence that will more than offset the toll taken from their number by the licensed hunter.

#### FOSSILS

FOSSILS FROM WYOMING.—Mr. George Olsen, of the department of vertebrate paleontology, American Museum, and Mr. Paul Miller, of Chicago University, temporarily attached to the staff of the Museum, spent a part of last summer collecting fossil vertebrates in the Eocene Bridger formation of Wyoming. A valuable collection, including skeletons of some of the rare and interesting primitive carnivores, rodents, etc., has been

sent to the Museum, and will be mentioned more fully in a later number of NATURAL HISTORY.

**DINOSAUR REMAINS NEAR NEW YORK.**—A fossil footprint of a dinosaur, recently presented to the American Museum by a member of the staff of that institution, Mr. E. D. Carter, reminds one that these reptiles once inhabited the country around New York. The footprint was found near Boonton, New Jersey, and as similar tracks have been found in the Connecticut valley, there is little doubt that these animals ranged over all the area between. Their bones have been found in the red shales and sandstones of Connecticut, but are very rare. Fossil skeletons seldom stand out from the weathered surface of the rock. They can be recognized, however, by their white or yellowish color and by the characteristic outlines of the vertebræ or limb bones.

#### CONSERVATION

**PUEBLOS OF NEW MEXICO THREATENED.**—The American Museum has coöperated with the Peabody Museum of American Archaeology and Ethnology and with other public-spirited bodies and individuals in an effort to protect the Pueblo Indians of New Mexico, threatened by the Bursum Land Bill, which proposed by an *ex post facto* act of Congress to legalize the illegal invasion by settlers of lands which these Indians have irrigated for centuries and on the retention of which, in that region of little water, their very existence depends. At the instance of Dr. Herbert L. Spinden, until recently associate curator of Mexican and Central American Archaeology, American Museum, President Henry Fairfield Osborn sent to a number of senators and congressmen the letter quoted below:

From very long experience and observation in all the states and territories of the West, since the year 1877, when I first went into Wyoming, and from subsequent journeys into Colorado, New Mexico, the Dakotas, Montana, Nebraska, and California, I am warmly in favor of preserving, both in letter and in spirit, our agreements with the Indians. I have especially observed in the Navajo Reservation the advantageous working of this principle.

Among all the Indians, none are so deserving of protection as the Pueblos—people who have never raised an arm against the United States and who have preserved their customs and culture as a wonderful and, in many respects, a beautiful monument of the past life of America.

Together with all my scientific colleagues and with the Trustees of the American Museum, I trust that Senate Bill 3855, known as the Bursum Land Bill, will not be passed by the House. It is the entering wedge which means not only the breaking of our national word but the breaking up of this most remarkable culture, which should be kept sacred by us, like our forests and great scenic wonders and beauties.

Trusting that you will not only oppose this Bill, but that you will use all reasonable influence against it, I am,

Respectfully yours,

HENRY FAIRFIELD OSBORN

President

It is gratifying to learn that this vicious Bill has been recalled by a resolution adopted by the Senate and that a preponderance of sentiment in Congress seems to be sternly arrayed against its passage.

**PRESERVATION OF THE PRONGHORN ANTELOPE.**—President Henry Fairfield Osborn of the American Museum has received a letter from Mr. Edward Seymour, president of the American Bison Society, which reports very favorable progress in the work to which that society is devoted, namely, the preservation of our fast-disappearing large game.

Mr. Seymour states that the Wichita preserve has recently received some additional specimens of the pronghorn antelope which were in fine condition. Part of a previous group of animals which had been brought to the preserve died from ticks, but the loss was made up through antelopes supplied under contract by Mr. C. J. Blazier of Alberta, Canada. Mr. Blazier, under the provisions of the license issued for the securing of antelope for preservation, has been quite successful in capturing these animals, and there are now available for distribution seventeen in addition to those which the Wichita preserve purchased.

There has been considerable difficulty in rearing antelope on preserves, because of the tick fever, but with experience it is hoped that some means of protection will be devised. It is possible that it will prove advisable to inoculate the antelope against fever.

The Society reports very generous responses to the campaign for stocking the Wichita preserve with pronghorn antelope.

The Society has been working hard on a census of the bison as well as on one of the pronghorn antelope, and has brought the task to completion. The United States Biological Survey has also been working on a census of the pronghorn antelope.

## THE CENTENARY OF LOUIS PASTEUR

On the evening of December 27, 1922, the American Museum was the scene of an impressive gathering in honor of Louis Pasteur, the Father of Bacteriology, whose centenary those assembled had come to commemorate. The New York Mineralogical Club and the American Museum of Natural History, under whose joint auspices the meeting took place, had associated with them in making the occasion a success the following organizations, institutions, and departments of the government: Alliance française de New York, American Scenic and Historic Preservation Society, United States Department of Agriculture, Department of Health of the City of New York, Federation de l'Alliance française, New York Academy of Sciences, New York Academy of Medicine, Pasteur Laboratories of America, Department of Health of the State of New York, Rockefeller Institute for Medical Research.

Those entering Memorial Hall of the American Museum were at once reminded of the significance of the occasion by the wreath-encircled and flag-draped bust of Pasteur, presented through Mrs. Henry Fairfield Osborn,—a replica of the bust by P. Dubois in the Rockefeller Institute. The flags of France and the United States were conspicuous in the auditorium, where the meeting took place.

President Henry Fairfield Osborn briefly introduced Dr. George F. Kunz, president of the New York Mineralogical Club, who acted as chairman of the evening. Doctor Kunz in his address sketched the various activities of Pasteur with special reference to his work in mineralogy. President Henry Fairfield Osborn, who was the first speaker called upon by Doctor Kunz, dwelt on the spiritual side of the life of Pasteur, emphasizing that "Pasteur will stand as a symbol of the intimate relation that must develop between the study of nature and the religious life of man" . . . "that the two great historical movements of love of humanity and knowledge of nature, of the spiritual and intellectual and physical well-being of man, are harmonious parts of a single and eternal truth," a belief stressed also in Professor Osborn's volume on Pasteur entitled *The New Order of Sainthood*. The Hon. Gaston Liebert, consul general of France, then gave a vivid picture of Pasteur, based on his personal knowledge of him. A letter bearing on the celebration of the cen-

tenary, signed by President Harding, and a telegram of a similar nature sent by the Hon. Charles Hughes, Secretary of State, were then read. The Hon. Hermann M. Biggs, commissioner, State Department of Health, New York, spoke about the great accomplishment of Pasteur in discovering a cure for hydrophobia. Dr. George D. Stewart, president of the New York Academy of Medicine, gave an illuminating account of some of Pasteur's contributions to medicine, a science which his discoveries revolutionized, shaking the whole structure of disease treatment to its foundations. There followed addresses by Dr. Pierre Lecomte du Nouy, of the Rockefeller Institute for Medical Research, who brought out the fact that "it is due to Pasteur that we have surgery that doesn't frighten us any more"; by Dr. Hideyo Noguchi, of the Rockefeller Institute for Medical Research, who spoke of Pasteur's contributions to bacteriology; by Major Henry J. Nichols of the Medical Corps, U. S. Army, whose topic was "The Value of Pasteur to the Army"; and by Professor C.-E. A. Winslow, honorary curator of public health, American Museum, who paid tribute to Pasteur for his splendid spirit of scientific research. In closing the exercises of the evening Director F. A. Lucas, of the Museum, explained scenes from the life of Pasteur as they were thrown on the screen.

SINCE the last issue of *NATURAL HISTORY* the following persons have been elected members of the American Museum, making the total membership, 6556:

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FOUNDED IN 1869

### MEMBERSHIP MORE THAN SIXTY-FIVE HUNDRED

For the enrichment of its collections, for the support of its explorations and scientific research, and for the maintenance of its publications, the American Museum of Natural History is dependent wholly upon membership fees and the generosity of friends. More than 6500 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

Associate Member (nonresident)*	annually	\$3
Annual Member	annually	10
Sustaining Member...	annually	25
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Patron		1,000
Associate Benefactor		10,000
Associate Founder		25,000
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\*Persons residing fifty miles or more from New York City

Subscriptions by check and inquiries regarding membership should be addressed: George F. Baker, Jr., Treasurer, American Museum of Natural History, New York City.

### NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM, FREE TO MEMBERS

NATURAL HISTORY, published bimonthly by the Museum, is sent to all classes of members as one of their privileges. Through NATURAL HISTORY they are kept in touch with the activities of the Museum and with the marvels of nature as they are revealed by study and exploration in various regions of the globe.

### COURSES OF POPULAR LECTURES FOR MEMBERS

A series of illustrated lectures, held in the Auditorium of the Museum on alternate Thursday evenings in the fall and spring of the year, is open only to members and to those holding tickets given them by members.

Illustrated stories for the children of members are told on alternate Saturday mornings in the fall and in the spring.

### MEMBERS' CLUB ROOM AND GUIDE SERVICE

A room on the third floor of the Museum, equipped with every convenience for rest, reading, and correspondence, is set apart during Museum hours for the exclusive use of members. When visiting the Museum, members are also privileged to avail themselves of the services of an instructor for guidance.

**The American Museum of Natural History** has a record of more than fifty years of public usefulness, during which its activities have grown and broadened, until today it occupies a position of recognized importance not only in the community it immediately serves but in the educational life of the nation. Every year brings evidence—in the growth of the Museum membership, in the ever larger number of individuals visiting its exhibits for study and recreation, in the rapidly expanding activities of its school service, in the wealth of scientific information gathered by its expeditions and disseminated through its publications—of the increasing influence exercised by the institution.

In 1922 no fewer than 1,309,856 individuals visited the Museum as against 1,174,397 in 1921, and 1,038,014 in 1920. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever. The **EXPEDITIONS** of the American Museum, working during the past year in several parts of Asia—where finds of extraordinary value were made—in South America, Africa, Australia, Europe, in the South Pacific Islands, in the West Indies, and in selected areas of our North American continent, have greatly enriched knowledge. Many habitat groups, embodying specimens secured by these expeditions, are planned for the new Museum buildings, the erection of which has been authorized by the city.

The **SCHOOL SERVICE** of the Museum reaches annually more than 4,000,000 boys and girls, through the opportunities it affords classes of students to visit the Museum; through lectures on natural history especially designed for pupils and delivered both in the Museum and in many school centers; through its loan collections, or "traveling museums," which during the past year circulated among 475 schools, with a total attendance of 1,648,608 pupils. During the same period 330,298 lantern slides were loaned by the Museum for use in the schools as against 209,451 in 1921, the total number of children reached being 2,582,585.

**LECTURES**, some exclusively for members and their friends, others for the general public, are delivered both in the Museum and at outside educational institutions.

The **LIBRARY**, comprising 100,000 volumes, is at the service of scientific workers and others interested in natural history, and an attractive reading room is provided for their accommodation.

The **POPULAR PUBLICATIONS** of the Museum, in addition to **NATURAL HISTORY**, include *Handbooks*, which deal with the subjects illustrated by the collections, and *Guide Leaflets*, which describe some exhibit, or series of exhibits, of special interest or importance, or the contents of some hall or some branch of Museum activity.

The **SCIENTIFIC PUBLICATIONS** of the Museum, based upon its explorations and the study of its collections, comprise the *Memoirs*, of quarto size, devoted to monographs requiring large or fine illustrations and exhaustive treatment; the *Bulletin*, issued since 1881, in octavo form, dealing with the scientific activities of the departments, aside from anthropology; the *Anthropological Papers*, recording the work of the staff of the department of anthropology; and *Novitates*, devoted to the publication of preliminary scientific announcements, descriptions of new forms, and similar matters.

*A detailed list of the publications, with prices, may be had upon application to the Librarian, American Museum of Natural History, New York City*